User guide and maintenance manual

VOLVO

Engine

TAD1343GE
TAD1344GE
TAD1345GE

7748641
01/06/2010

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OPERATOR'S MANUAL

Generating set and industrial engines

13 liter (EMS 2)

CALIFORNIA PROPOSITION 65 WARNING

Engine exhaust, some of its constituents, and a broad range of engine parts are known to the State ofCalifornia to cause cancer, birth defects, and other reproductive harm. Additionally, lubricants, fuels, andother fluids used in engines–including any waste created through the wearing of engine parts–contain orproduce chemicals known to the State of California to cause cancer and birth defects or other reproductiveharm.

Battery posts, terminals, and related accessories contain lead and lead compounds. Wash your hands afterhandling. Used engine oil contains chemicals that have caused cancer in laboratory animals. Alwaysprotect your skin by washing thoroughly with soap and water.

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Foreword

Volvo Penta engines are used all over the world. They are used in all possible operating conditions. This is not a coincidence. After 100 years as an engine manufacturer the Volvo Penta name has become a symbol of reliability, technical innovation, top of the range performance and long service life. We also believe that this is what you demand and expect of your Volvo Penta engine.

We would like you to read this operator's manual thoroughly and consider the advice we give on running and maintenance. Please pay attention to the safety instructions contained in the manual.

As owner of a Volvo Penta engine, we would also like to welcome you to a worldwide network of dealers and service workshops to assist you with technical advice, service requirements and replacement parts. Please contact your nearest authorized Volvo Penta dealer for assistance.

You will find your closest dealer at our home page on the Internet www.volvopenta.com - amongst other useful information about your Volvo Penta engine - we invite you to visit!

Safety Information

Read the Operators Manual through very carefully before you start the engine or do any maintenance or service. It has to do with your safety, an incorrect operation can lead to personal injury and damage to products or property. This chapter describes how safety precaution is presented in the Operators Manual and on the product. It also gives you an introduction to the basic safety rules for using and looking after the engine.
If there is still something which is unclear or if you feel unsure about it, please contact your Volvo Penta dealer for assistance.

NOTICE! Check that you have received the correct operator's manual before you read on. If not, please contact your Volvo Penta dealer.

This symbol is used in the Operators Manual and on the product, to call your attention to the fact that this is safety information. Always read such information very carefully.
Safety texts in the Operators Manual have the following order of priority:

⚠ DANGER!

Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

⚠ WARNING!

Indicates a hazardous situation which, if not avoided, could result in death or serious personal injury.

⚠ CAUTION!

Indicates a hazardous situation which, if not avoided, could result in minor or moderate personal injury.

IMPORTANT!
Indicates a situation which, if not avoided, could result in property damage.

NOTICE! Used to draw your attention to important information that will facilitate the work or operation in progress.

This symbol is used on our products in some cases and refers to important information in the Operators Manual. Make sure that warning and information symbols on the engine are clearly visible and legible. Replace symbols which have been damaged or painted over.

Safety rules for operation and maintenance

Daily checks
Make it a habit to give the engine and engine bay a visual check before starting **(before the engine is started**) and after operation (**once the engine has stopped**). This helps you to quickly discover whether any leakage of fuel, coolant, oil or any other abnormal event has happened, or is about to happen.

Carbon monoxide poisoning
Only start the engine in a well ventilated area. When operated in a confined space, exhaust fumes and crankcase gases must be ventilated.

Cooling System
Avoid opening the coolant filling cap when the engine is hot. Steam or hot coolant can spray out and cause scalding, at the same time as the pressure built up is lost.
If the filler cap, coolant hose etc., still has to be opened or removed when the engine is hot, undo the filler cap slowly and carefully, to let the pressure out before removing the filler cap completely and starting work. Note that the coolant can still be hot and cause scalding.

Fuel and lubrication oils
Always protect your hands when searching for leaks. Fluids which leak under pressure can force their way into body tissue and cause severe injury. There is a risk of blood poisoning (septicemia).
Only use the fuel recommended in the Operators Manual. The wrong grade of fuel can cause malfunctions or stop the engine. In a diesel engine, it can also cause the injection pump to seize and the engine will over-rev, entailing a strong risk of personal injury and machinery damage.
Always cover the alternator if it is located beneath the fuel filters. Fuel spillage can damage the alternator.
Always change the oil, oil filter and fuel filter at the specified intervals.

Starting lock
If the instrument panel does not have a key switch, the engine room must be lockable, to prevent unauthorized persons from starting the engine. Alternatively, a lockable main switch can be used.

Hot surfaces and fluids
A hot engine always increases the risk for burns. Be on your guard against hot surfaces: the exhaust manifold, turbocharger, oil pan, charge air pipe, starting heater, hot coolant and hot lubricating oil in pipes, hoses etc.

Fuel filling
There is always a risk of fire and explosion during fuel filling. Smoking is forbidden, and the engine should be stopped.
Never overfill the tank. Shut the tank cap securely.
Only use the fuel recommended in the Operators Manual. The wrong grade of fuel can cause malfunctions or stop the engine. In a diesel engine, it can also cause the injection pump to seize and the engine will over-rev, entailing a strong risk of personal injury and machinery damage.

Operation
The engine must not be operated in environments which contain explosive media since none of the electrical and mechanical components are explosion proof.
Going close to a running engine is a safety risk. Hair, fingers, loose clothes, or dropped tools can catch on rotating components and cause severe injury.
When engines are supplied without touch guards, all rotating components and hot surfaces must be protected after installation in their application, if necessary for personal safety.

Care and maintenance

Knowledge
The Operators Manual contains instructions for doing the most common service and maintenance tasks in a safe and correct manner. Read them carefully before starting work.
Literature for more major tasks is available from your Volvo Penta dealer.
Never do a job if you are not entirely sure about how to do it. Please contact your Volvo Penta dealer and ask for assistance instead.

Stopping the engine
Stop the engine before opening or removing the engine hatch/hood. Service and maintenance work should be done with the engine stopped unless otherwise specified.
Prevent the engine from being started by pulling out the starter key and disconnect the power with the main switch. Lock them in the “Off” position.
If the instrument panel does not have a key switch, remove the system voltage with the main switch.
Fix a notice by the operator position to say that work is in progress.
Working with, or approaching a running engine is a safety risk. Hair, fingers, loose clothes, or dropped tools can catch on rotating components and cause severe injury. Volvo Penta recommends that all service work which requires the engine to be running should be done by an authorized Volvo Penta workshop.

Before starting
Re-install all guards which have been removed during service work, before re-starting the engine. Make sure that there are no tools or other objects left behind on the engine.
Never start a turbocharged engine without the air filter in place. The rotating compressor turbine in the turbocharger can cause severe injury. There is also a risk that foreign bodies could be sucked in and cause damage to the machinery.

Lifting the engine
The lifting eyes fitted on the engine should be used for lifting. Always check that the lifting devices are in good condition and that they have the correct capacity for the lift (engine weight together with auxiliaries, if fitted). The engine should be lifted with an adjustable lifting boom for safe handling. All chains or cables should be parallel to each other and should be as square as possible to the top of the engine. Please note that auxiliary equipment installed on the engine could change its center of gravity. Special lifting devices may then be needed to obtain the correct balance and safe handling. Never carry out work on an engine that is **only** suspended in a hoist.

Fire and explosion

Fuel and lubrication oil
All fuel, most lubricants and many chemicals are flammable. Always read and observe the advice on the packages.
Work on the fuel system must be done with the engine cold. Fuel leakage and spills on hot surfaces or electrical components can cause fires.
Store oil and fuel soaked rags and other flammable material in a fireproof manner. Oil soaked rags can self-ignite in certain circumstances.
Never smoke when filling fuel, lubrication oil or when close to fuel filling stations or the engine bay.

Spare parts
Components in fuel systems and electrical systems on Volvo Penta engines are designed and manufactured to minimize the risk of explosions and fire, in accordance with applicable legal requirements.
The use of spare parts not approved by Volvo Penta can cause an explosion or fire.

Batteries
Batteries contain and give off an explosive gas, especially when charged. This gas is very flammable and highly explosive.
Smoking, open flames or sparks must never occur in or near to batteries or the battery locker.
Incorrect connection of a battery cable or start cable can cause a spark which can be sufficient, in its turn, to make the battery explode.

Start spray
Never use start spray or similar preparations to help in starting an engine with air pre-heating (glow plugs / starting heater). They may cause an explosion in the inlet manifold. Danger of personal injury.

Electrical System

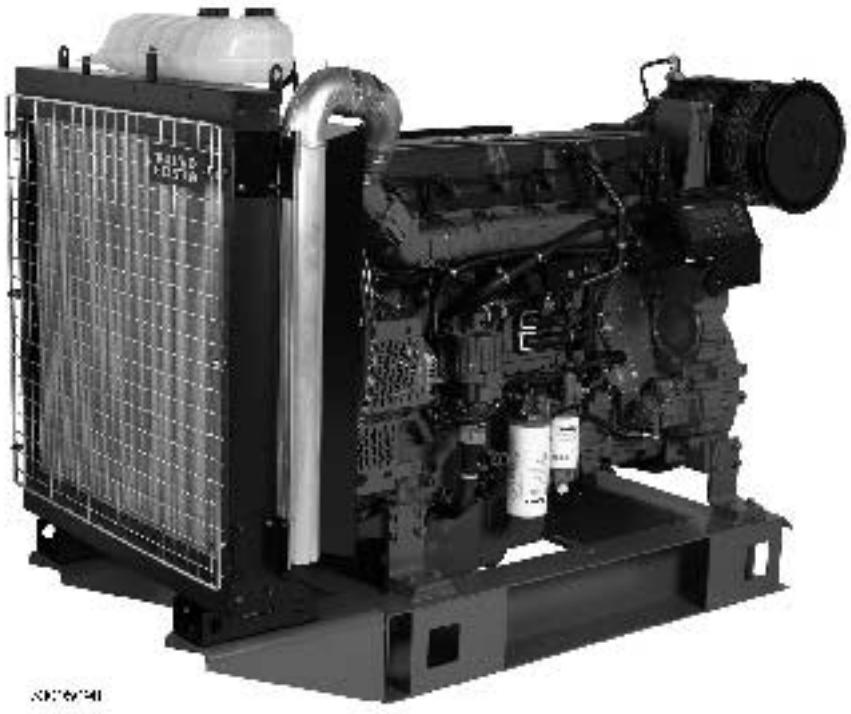
Disconnect the power
Before any work is done on the electrical system, the engine must be stopped and the power removed by switching off the main switch(es). Any external power supply for engine heaters, battery chargers or other auxiliary equipment connected to the engine must be disconnected.

Electric welding
Remove the positive and negative cables from the batteries.
Then disconnect all cables connected to the alternator. Disconnect both connectors from the engine control module.
Always connect the welder earth clamp to the component to be welded, and as close as possible to the weld site. The clamp must never be connected to the engine or in such a way that current can pass through a bearing.
When welding is completed: Always connect the cables to the alternator **and engine control unit connector before** reconnecting the battery cables.

Batteries
Batteries contain a highly corrosive electrolyte. Protect your eyes, skin and clothes during charging and other handling of batteries. Always use protective goggles and gloves.
If acid comes into contact with your skin, wash at once with soap and a lot of water.
If you get battery acid in your eyes, flush at once with a lot of cold water, and get medical assistance at once.

Introduction

This Operator's Manual refers to the industrial engines TAD1341GE, TAD1342GE, TAD1343GE, TAD1344GE, TAD1345GE, TAD1350GE, TAD1351GE, TAD1352GE, TAD1353GE, TAD1354GE, TAD1355GE, TAD1340VE, TAD1341VE, TAD1342VE, TAD1343VE, TAD1344VE, and TAD1345VE.
They are in-line, six-cylinder, direct injection industrial diesel engines. All of the engines are equipped with electronically controlled fuel management (EMS), turbocharger, charge air cooler, thermostatically controlled cooling systems and electronic speed control.
The Operator's Manual contains the information you need to be able to operate and maintain your Volvo Penta safely and correctly. Please read the manual carefully and learn to handle the engine and other equipment in a safe manner before you start the engine.



NOTICE! The manual describes the engine and equipment sold by Volvo Penta. Differences in appearance and function of the controls and instruments may occur in certain variants. In these cases, please refer to the Operator's Manual for the relevant application.

NOTICE! When ordering service or spares, always indicate the engine and transmission identification number. Refer to *Technical Data page 71*.

Warranty

Your new Volvo Penta industrial engine is covered by a limited warranty, according to the conditions and instructions compiled in the Warranty and Service book.
Please note that AB Volvo Penta's liability is limited as specified in the Warranty and Service Book. Read it carefully, as soon as possible after delivery. It contains important information about the warranty card, service intervals and service that the owner must be aware of, check and perform. If this is not done, AB Volvo Penta may disclaim its warranty obligations in part or in full.
Please contact your Volvo Penta dealer if you have not received a Warranty and Service book, or a customer copy of the warranty card.

Environmental responsibility

All of us want to live in a clean, healthy environment, where we can breathe clean air, see healthy trees, have clean water in lakes and seas, and be able to enjoy the sunlight without fearing for our health. Unfortunately, this is not a matter of course these days, but something we all must work toward.
As an engine manufacturer, Volvo Penta has special responsibility, and for this reason environmental care is a natural cornerstone of our product development. Volvo Penta currently has a broad engine program in which considerable progress has been made in reducing exhaust emissions, fuel consumption and engine noise etc.
We hope that you will be keen to preserve these qualities. Always follow the advice in the Operator's Manual about fuel grades, operation and maintenance, to avoid unnecessary environmental impact. Contact your Volvo Penta dealer if you notice any changes such as increased fuel consumption or increased exhaust smoke.
Remember always to hand in hazardous waste such as drained oil, coolant, old batteries etc. for destruction at a recycling facility.
If we unite our efforts, we can make a valuable contribution to the environment together.

Running in

The engine must be “run in” during its first 10 hours, as follows:
Run the engine in normal operations. However, full load may not be applied other than for short periods. Never run the engine for an extended period of time at constant speed during this period: this does not apply to GE engines.
Higher oil consumption is normal during the first 100-200 hours of operation. For this reason, check the oil level more frequently than normally recommended. When a disengageable clutch is installed, it should be checked more carefully during the first days. Adjustments may be necessary to compensate for bedding in of the friction plates.

Maintenance and replacement parts

Volvo Penta engines are designed for maximum reliability and long life. They are built to withstand a demanding environment, but also to have the smallest possible environmental impact. These qualities are retained through regular service and use of genuine Volvo Penta parts.
Volvo Penta has a world-wide network of authorized dealers. They are Volvo Penta product specialists, and have the accessories, genuine parts, test equipment and special tools needed for high quality service and repair work.
Always follow the maintenance intervals in the manual, and remember to note the engine/transmission identification number when you order service and replacement parts.

Certified Engines

If you own an emission-certified engine used in an area where exhaust emissions are regulated by law, it is important to be aware of the following:
Certification means that an engine type has been checked and approved by the relevant authority. The engine manufacturer guarantees that all engines of the same type are equivalent to the certified engine. This places special demands on the care and maintenance you provide your engine, namely:

- Maintenance and service intervals recommended by Volvo Penta must be complied with.
- Only genuine Volvo Penta parts may be used.
- Service on injection pumps, pump settings and injectors must always be done by an authorized Volvo Penta workshop.
- The engine must not be converted or modified, except with accessories and service kits which Volvo Penta has developed for the engine.
- No installation changes to the exhaust pipe and engine air inlet ducts may be made.
- No warranty seals (where present on the product) may be broken by unauthorized persons.

The general instructions in the Operator's Manual concerning operation, service and maintenance apply.

NOTICE! Neglected or poorly performed care/service, as well as the use of non-genuine spare parts, will mean that AB Volvo Penta no longer can guarantee that the engine conforms to the certified model. Damages and/or costs arising from this will not be compensated by Volvo Penta.

Presentation

EMS (Engine Management System)

EMS (Engine Management System) is an electronic system with CAN communication (Controller Area Network) for diesel engine control. The system has been developed by Volvo Penta and includes fuel control and diagnostic functions.
The system comprises among other things sensors, a control unit and unit injectors. The sensors send input signals to the control unit, which in turn controls the unit injectors.

Diagnostic function
The purpose of the diagnostic function is to detect and localize any malfunctions in the EMS system, to protect the engine and to ensure operation in the event of serious malfunction.
If a malfunction is detected, this is announced by warning lamps, a flashing diagnostic lamp or in plain language on the instrument panel, depending on the equipment used. If a fault code is obtained as a flashing code or in plain language, it is used for guidance in any fault tracing. Fault codes can also be read by Volvo's VODIA tool at authorized Volvo Penta workshops.
If there is a serious malfunction, the engine will be shut down altogether, or the control unit will reduce the power delivered (depending on application). Once again, a fault code is set for guidance in any fault tracing.

Fuel control
The engine fuel requirement is analyzed up to 100 times per second. The amount of fuel injected into the engine and the injection advance are fully electronically controlled via fuel valves and the unit injectors. This means that the engine always receives the correct volume of fuel in all operating conditions, which provides lower fuel consumption, minimal exhaust emissions etc

Input signals
The control unit receives input signals about engine operating conditions etc. from the following components:

- coolant temperature sensor
- charge pressure / charge temperature sensor
- crankcase pressure sensor
- position sensor, camshaft
- rpm sensor, flywheel
- coolant level sensor
- oil level and temperature sensor
- oil pressure sensor
- fuel pressure sensor
- water-in-fuel indicator

Output signals
The control module uses the input signals to control the following components:

- unit injectors
- starter motor
- main relay
- pre-heating relay

The information from the sensors provides precise data about prevailing operating conditions and allows the processor in the control module to, among other things, calculate correct injection amount, injection timing and check the engine's condition.

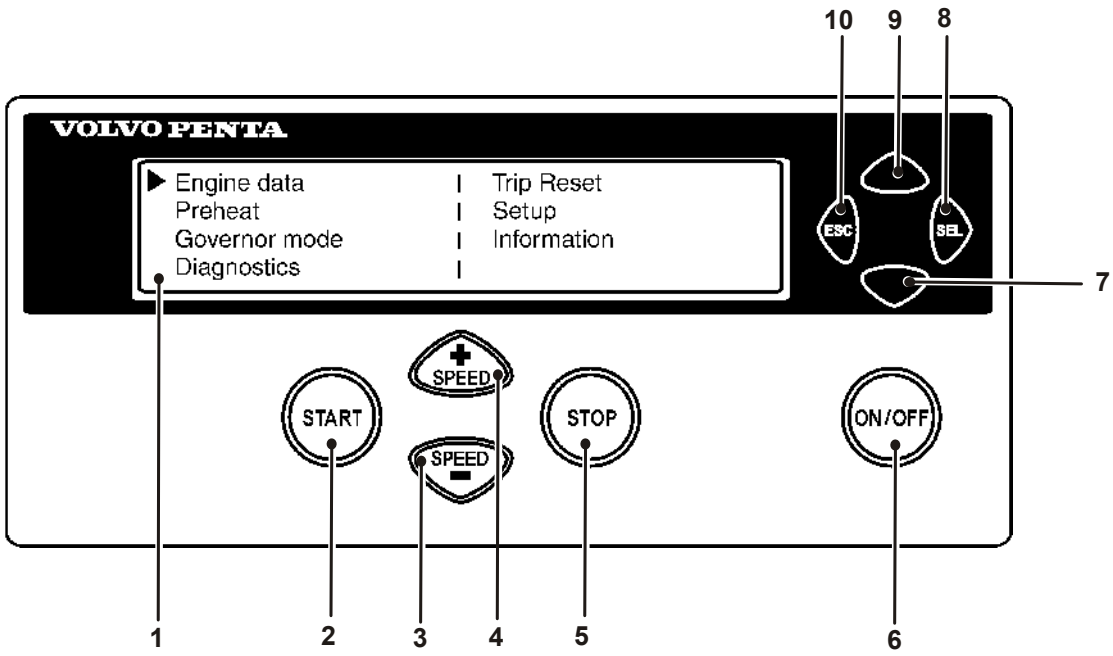
Instruments and Controls

DCU (Display Control Unit)

The DCU (Diesel Control System) control panel is available as an optional accessory for the EMS (Engine Management System) electronic control system.
The DCU is a digital instrument panel which communicates with the engine control unit. The DCU has several functions, such as engine control, monitoring, diagnostics, and parameter setting.

The menus in the DCU system can be used to check, and in some cases to set, a number of different functions in the EMS system.

NOTICE! The menus and illustrations shown here are the English version. The language can be changed, however; refer to the *Setup* menu.



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1 LED display
2 START. Starts the engine
3 SPEED - . Reduces engine rpm
4 SPEED +. Increases engine rpm
5 STOP. Stops the engine
6 ON/OFF. Starts and stops the system
7 Scroll downwards in menus
8 SEL. Selects in menus
9 Scroll upwards in menus
10 ESC. Return to previous menu selection

Start

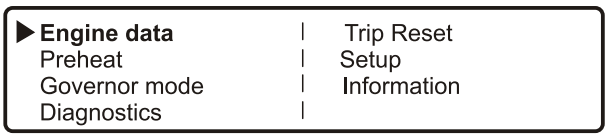
When the DCU panel is started, the “Engine Data” menu is displayed; press “ESC” to come to the main menu.

Menus

There are several sub-menus under each main menu. There is not space for all the menu choices on the display. To scroll through the menus, use the **7** and **9** buttons on the display. Press the **SEL** button **8** to make a selection. Refer to the illustration on the previous page.

NOTICE! The **Setup** menu can be used to select the language that you want to use on the display.

Main menu



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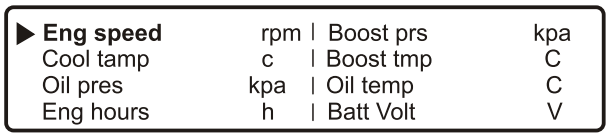
- **Engine data**, current engine data
- **Preheat**, manual activation of pre-heating. Must be activated with temperatures below 0°C (32°F)
- **Governor mode**. activation of droop
- **Diagnostics**, shows fault codes as text
- **Trip reset**, resets trip data
- **Setup**, parameter setting
- **Information**, shows the currently applicable hard/ software, data sets and engine identification for the engine and DCU data

Engine data



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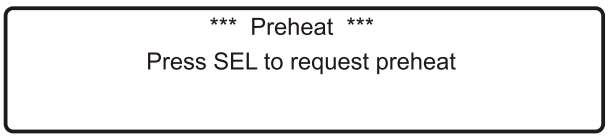
shows relevant engine data.

- Engine speed, can be controlled with the **SPEED+** and **SPEED–** buttons (rpm)
- Charge pressure (kPa)
- Coolant temperature (°C)
- Charge air temperature (°C)
- Oil pressure (kPa)
- Oil temperature (°C)
- Engine hours (h)
- Battery voltage (V)
- Fuel consumption (l/h)
- Instantaneous fuel consumption (trip fuel) (l)



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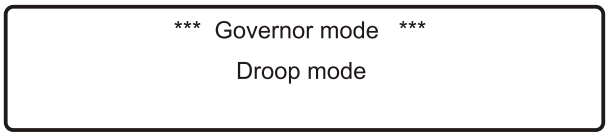
Preheat

manual activation of pre-heating. When it is activated, the EMS system senses at start-up if pre-heating is needed. For automatic pre-heating, refer to the *Setup / Preheat on ignition* menu.

NOTICE! Must be activated with temperatures below 0°C (32°F).

The pre-heating time is adjusted to suit the engine temperature, and can last for up to 50 seconds both before and after starting. Refer also to *Starting procedure EMS*.

- Press **SEL**, the text **Preheat requested** will be shown
- The display automatically returns to the **Engine Data** menu.



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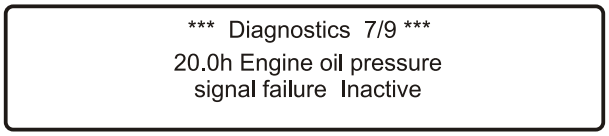
Governor mode

activates/shuts off droop. To set the droop level, refer to the *Setup / Governor gradient or Governor droop* menu.

- Select **Isochronous mode** or **Droop mode** with the SEL button.



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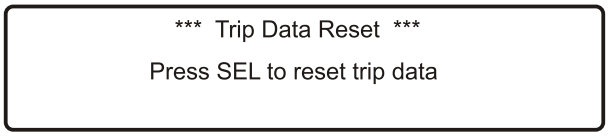
Diagnostics

shows the error list containing the 10 latest active and inactive faults. The fault codes are shown as text on the display.

- Scroll through the fault list with the arrow keys.



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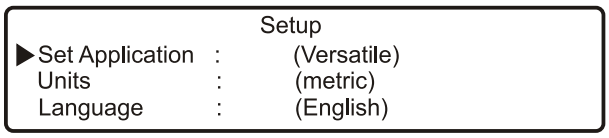
Trip Data reset

resets trip data, such as fuel consumption.

- Press the **SEL** button to reset trip data



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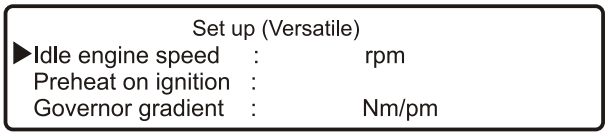
Setup

parameter setting in the engine's control systems. Different menus appear under **Customer parameter**, depending on whether **Versatile** or **Gen set** has been selected from **Set application**. See below.

The parameters that can be set/selected (choice is made with the SEL button) are:

- **Set application**, setting **Versatile** or **Gen set**. Depending on the selection made here, different menus will appear under **Customer parameter**.
- **Unit**, setting of units (metric or US imperial).
- **Language**, setting the language used on the display. Choose between English, French, German and Spanish.
- **Stop energized to**, setting of external stop input. Activated by **Stop** or **Run**.
  Stop: The stop input must be connected to voltage to stop the engine.
  Run: The stop input must be connected to voltage to run the engine.
- **Customer parameter**, setting alarm limits. Refer to *Customer parameter / Versatile and Customer parameter / Gen set*.
- **Throttle input setting**, setting of engine-speed control and voltage limits. Refer to *Throttle input setting*.
- *Display setting*, setting the display. refer to *Display setting*.



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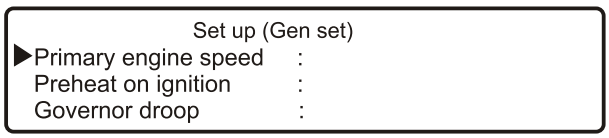
Customer parameter / Versatile

- **Idle engine speed** - setting idle speed.
- **Preheat on ignition** - activation of automatic preheating. The engine control system senses if preheating is needed and activates it directly at switch-on.
- **Governor gradient (Nm/rpm)** - setting of droop level, when activated. For activation, refer to *Governor droop* in the main menu.
- **Oil temp warning limit (°C)** - setting alarm limit for oil temperature.
- **Coolant temp warning limit (°C)** - setting alarm limit for coolant temperature.

Customer parameter / Gen set



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- **Primary engine speed** - selection of engine rpm, 1500 or 1800 rpm.
- **Preheat on ignition** - activation of automatic pre-heating. The engine control system senses if pre-heating is needed and activates it directly at switch-on.
- **Governor droop (%)** - setting of droop level, when activated. For activation, refer to “Governor droop” in the main menu.
- **Overspeed limit (%)** - setting of limit for overspeed alarm, % of set engine rpm.
- **Overspeed shutdown** - activation of engine shut-down with overspeed alarm. Refer to “Overspeed limit” to activate the alarm limit for the excess rpm alarm.
- **Oil temp warning limit (°C)** - setting alarm limit for oil temperature.
- **Coolant temp limit (°C)** - setting alarm limit for coolant temperature.

Throttle input setting

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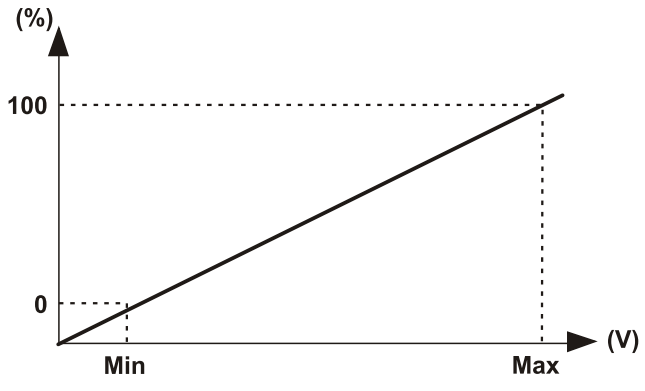
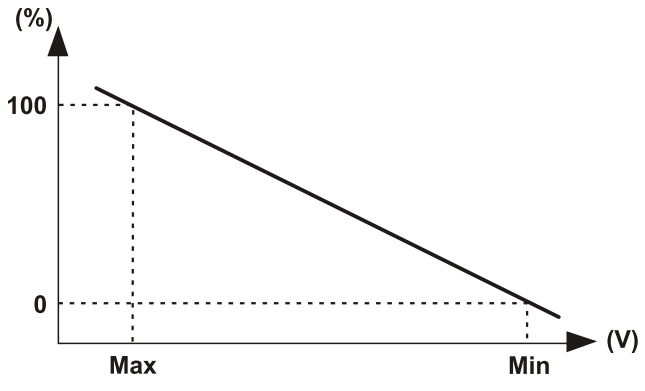
rpm control setting (throttle operation).

- **Set throttle mode** - OFF - engine rpm is controlled via the DCU panel.
  ext throttle input - engine speed is controlled with a potentiometer (accelerator).
  ext voltage input - engine rpm is controlled by an external unit.
- **Set idle voltage (V)** - idle voltage level setting.
- **Set max voltage (V)** - full throttle voltage level setting.





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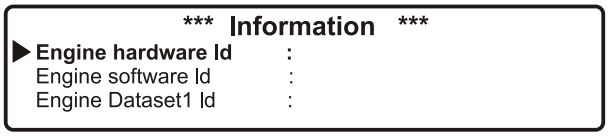
Display setting

settings for the display. Adjustment is made with the **7** and **9** buttons; see DCU panel illustration.

- **Set contrast (%)** - contrast setting.
- **Set backlight time (sec)** - time setting (in seconds) for display backlighting on, lighting is then shut off if the panel is not used.
- **Set backlight brightness** - display backlighting brightness setting.

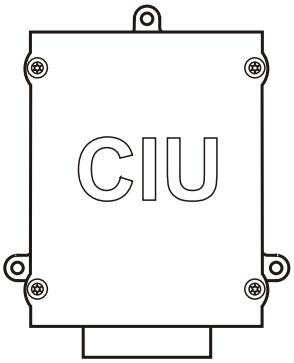


P0002076

Information

shows the data for the engine and DCU.

- **Engine hardware Id** - engine control unit part number.
- **Engine software Id** - engine control unit software part number.
- **Engine dataset1 Id** - engine data set 1 part number.
- **Engine dataset2 Id** - engine data set 2 part number.
- **Vehicle Id** - chassis number.
- **DCU hardware Id** - DCU part number.
- **DCU software Id** - DCU software part number.
- **DCU dataset1 Id** - DCU data set 1 part number.
- **DCU dataset2 Id** - DCU data set 2 part number.



P0002060

CIU (Control Interface Unit)

The CIU is a "translator" between the control unit (EMS) and the customer's own control panel. The CIU has two serial communication links, one fast and one slow.

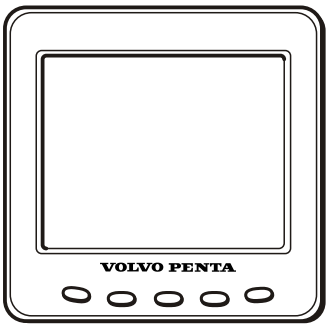
The fast one is a so-called CAN link. All data related to instruments, indication lamps, connectors and potentiometers is controlled by this link.

The slow link manages diagnostic information for flashing codes etc.

Easy Link Instruments

The following Easy Link instruments are available:

- Tachometer / hours counter (fault codes are also displayed on the tachometer display when the diagnostic button is pressed)
- Coolant temperature
- Oil pressure
- Oil temperature
- Battery voltage
- Alarm panel
- Turbo pressure



P0002061

DU (Display Unit)

The DU is an instrument panel which shows engine working values graphically on an LCD screen. It consists of an computerized unit for permanent installation in a control panel.

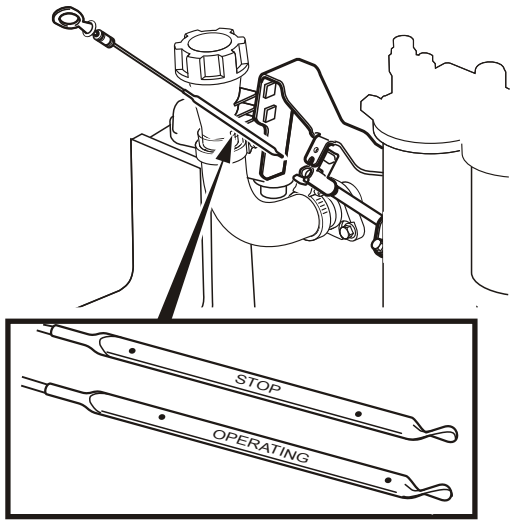
The DU is connected between the engine control unit and the CIU or DCU.

Starting

Make it a habit of giving the engine and engine room a visual check before starting. This will help you to discover quickly if anything abnormal has happened, or is about to happen.
Also check that instruments and warning displays show normal values after you have started the engine.

⚠ WARNING!

Never use start spray or similar products as starting aid. Explosion risk!



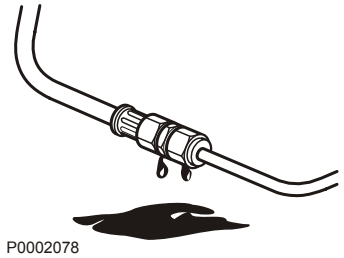
P0004311

Before Starting

- Check that the oil level is between the MAX and MIN marks.

NOTICE! The oil level can be read both when the engine is stationary (the STOP side of the dipstick) and with the engine running (the OPERATING side of the dipstick).
For topping up please refer to the *Oil level, checking and topping up page 50*.

- Open the fuel stopcocks.


P0002078

- Check that no leakage of oil, fuel or coolant occurs.
- Check the coolant level and that the radiator is not-blocked externally. Please refer to *Coolant Level, Checking and Topping Up page 56* and *Charge Air Cooler, External Cleaning page 57*

  ⚠ WARNING!

  Do not open the coolant filler cap when the engine is warm, except in emergencies, this could cause serious personal injury. Steam or hot fluid could spray out.

- Turn the main switch(es) on.
- Move the engine speed control to idle, and disengage the clutch/gearbox if installed.

IMPORTANT!

Never disconnect the current with the main switch(es) when the engine is running. This can damage the alternator.

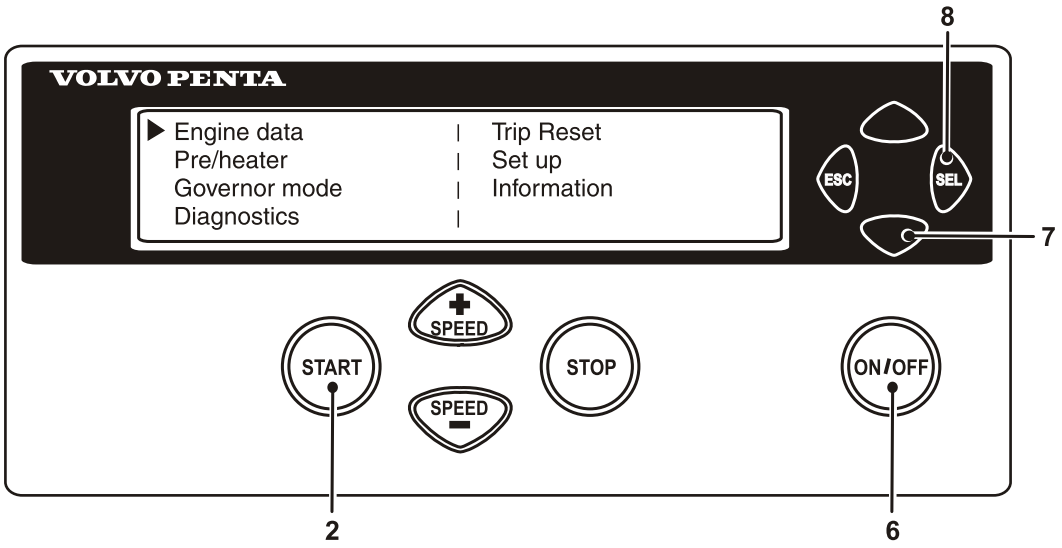
Starting the Engine

EMS (Engine Management System)

The pre-heating time is adjusted to suit the engine temperature, and can last for up to 50 seconds both before and after starting.

The starter motor connection time is maximized to 20 seconds. After that, the starter motor circuit is cut for 80 seconds to protect the starter motor against over-heating.

DCU (Display Control Unit)



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With pre-heating

1 Depress the **ON/OFF**-button (6).

2 Press the **SEL** button (8) to come to the main-menu.

3 Scroll down to **Pre/heater** with scroll button (7),press **SEL**-button (8)

4 In the **pre-heater** menu, press the **SEL**-button (8) to select pre-heating.

5 Press the **START**- button (2).

Without pre-heating

1 Depress the **ON/OFF**-button (6).

2 Press the **START**-button (2).

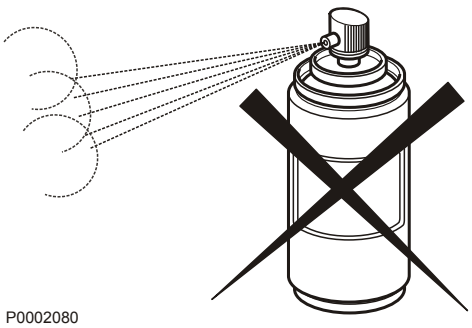
Leave the engine to idle for the first 10 seconds. Then warm the engine up at low speed and under low load. Never race the engine when it is cold.

Starting in Extreme Cold

Certain preparations must be made to facilitate engine starting, and in some cases to make starting possible at all:

- Use a winter grade fuel (of a well-known make) which has been approved for the relevant temperature. This reduces the risk of wax deposits in the fuel system. At extremely low temperatures, the use of a fuel heater is recommended.
- For fully acceptable lubrication, a synthetic engine oil of recommended viscosity for the relevant temperature should be used. Please refer to the *Maintenance, lubrication system* chapter. Synthetic lubricants are able to manage a wider temperature range than mineral-based lubricants.
- Pre-heat the coolant with a separately installed eletric engine heater. In extreme cases, a diesel-burning engine heater may be needed. Ask your Volvo Penta dealer for advice.
- Make sure that the cooling system is filled with a glycol mixture. Please refer to the *Maintenance, cooling system* chapter.
- The batteries should be in good condition. Cold weather reduces battery capacity. Increased battery capacity may be necessary.

Never Use Start Spray



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⚠ WARNING!

Never use start spray or similar products as starting aid. Explosion risk!

Starting Using Auxiliary Batteries

⚠ WARNING!

Explosion hazard. Batteries contain and give off an explosive gas which is highly flammable and explosive. A short circuit, open flame or spark could cause a violent explosion. Ventilate well.

1 Check that the auxiliary batteries are connected (series or parallel) so that the rated voltage corresponds to the engine system voltage.

2 First connect the red (+) jumper cable to the auxiliary battery, then to the flat battery. Then connect the black (-) jumper cable to the auxiliary battery and to a location that is **somewhere away from the discharged battery**, e.g. the main switch negative terminal or the negative terminalon the starter motor.

3 Start the engine.

⚠ WARNING!

Do not touch the connections during the start attempt: Risk of arcing.

Do not bend over any of the batteries either.

4 Remove the cables in the reverse order.

IMPORTANT!

The ordinary cables to the standard batteries must not be loosened on any condition.

Operation

Correct operating technique is very important for both fuel economy and engine life. Always let the engine warm up to normal operating temperature before operating at full power. Avoid sudden throttle openings and operation at high engine rpm.

Reading the Instruments

Check all instruments directly after starting, and then regularly during operation.

NOTICE! On engines in continuous operation, the lubrication oil level must be checked at least every 24 hours. Refer to *Oil level, checking and topping up page 50*.

Alarms

If the EMS system receives abnormal signals from the engine, the control unit generates fault codes and alarms, in the form of lamps and audible warnings. This is done by means of CAN signals to the instrument.

More information about fault codes and fault tracing can be found in the chapter. *Alarm handling*.

Maneuvering

Operation at low load

Avoid long-term operation at idle or at low load, since this can lead to increased oil consumption and eventually to oil leakage from the exhaust manifold, since oil will seep past the turbocharger seals and accompany the induction air into the inlet manifold at low turbo pressure.
One consequence of this is carbon build-up on valves, piston crowns, exhaust ports and the exhaust turbine.

At low loads, the combustion temperature may become so low that complete combustion cannot be ensured, resulting in possible fuel dilution of lubricating oil and eventually leakage from the exhaust manifold.

If the following points are done as a complement to normal maintenance, there will be no risk of malfunctions caused by operation at low load.

- Reduce operation at low load to a minimum. If the engine is regularly test-run without load once a week, the duration of this operation should be limited to 5 minutes.
- Run the engine at full load for about 4 hours once a year. In this way carbon deposits in the engine and exhaust system are given the chance to burn up.

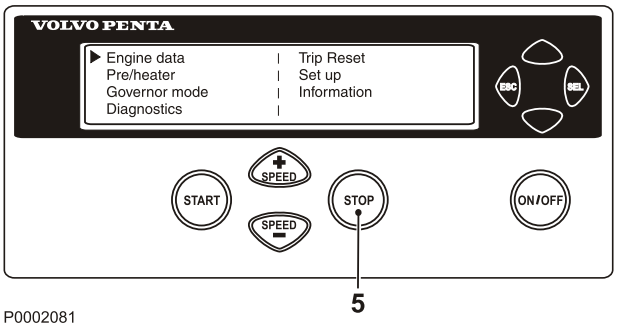
Engine Shutdown

During longer breaks in operation, the engine must be warmed up at least once every two weeks. This prevents corrosion in the engine. If you expect the engine to remain unused for two months or more, it must be laid up: Refer to the chapter *Storage page 64*.

Before Engine Shutdown

Let the engine run for a few minutes without loading before stopping it. This allows engine temperature equalization and prevents boiling once stopped and also allows the turbocharger to cool down. This contributes to long service life without malfunctions.

Stop the Engine



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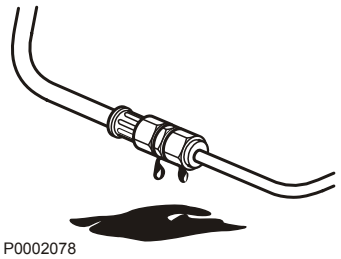
- Disengage the clutch (if possible).
- Depress the **STOP**-button (5).

After Engine Shutdown



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1 Check the engine and engine bay for leakage.

2 Turn off the main switches before any long stoppage.

3 Carry out maintenance in accordance with the schedule.

For longer breaks in operation

During longer breaks in operation, the engine must be warmed up at least once every two weeks. This prevents corrosion attacks in the engine.
If you expect the engine to be unused for two months or more, it must be laid up. Refer to the chapter *Short Term Storage*.

NOTICE! If there is a risk of frost, the coolant in the cooling system must have sufficient frost protection. Refer to the chapter *Maintenance page 54*.
A poorly-charged battery can freeze and burst; refer to *Battery, Charging page 62*.

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Extra Stop

For location of the extra stop, please refer to *Maintenance page 46*.

⚠ WARNING!

Working with or going close to a running engine is a safety risk. Watch out for rotating components and hot surfaces.

Fault Handling

Fault Tracing

A number of symptoms and possible causes of engine malfunctions are described in the table below. Always contact your Volvo Penta dealer if any problems occur which you can not solve by yourself.
NOTICE! Read through the safety advice for care and maintenance work in the chapter *Safety Information page 3* before you start work.

Symptoms and possible causes	
The diagnosis button lamp flashes	Please refer to *Alarm handling*
Engine can not be stopped	2, 5
Starter motor does not rotate	1, 2, 3, 4, 5, 6, 7, 24
Starter motor rotates slowly	1, 2
Starter motor rotates normally but the engine does not start	8, 9, 10, 11,
Engine starts but stops again	8, 9, 10, 11, 13
Engine does not reach correct operating speed at full throttle	9, 10, 11, 12, 13, 21, 25, 26
Engine runs roughly	10, 11
High fuel consumption	12, 13, 15, 25
Black exhaust smoke	12, 13
Blue or white exhaust smoke	15, 22
Too low lubrication oil pressure	16
Excessive coolant temperature	17, 18, 19, 20
Too low coolant temperature	20
No, or poor charge	2, 23

1 Discharged batteries

2 Poor contact/open circuit in electrical wiring

3 Main switch turned of

4 Main fuse faulty

5 Faulty ignition lock

6 Faulty main relay

7 Faulty starter motor-/solenoid

8 No fuel:
– fuel cocks closed
– fuel tank empty/wrong tank connected

9 Blocked fuel fine-filter/pre-filter (due to contaminations, or stratification in the fuel at low temperature)

10 Air in the fuel system

11 Water/contamination in fuel

12 Faulty unit injectors

13 Insufficient air supply to the engine:
– blocked air filter
– air leakage between the turbo and the engine's intake manifold
– dirty compressor part in the turbocharger
– faulty turbo compressor
– poor engine room ventilation

14 Coolant temperature too high

15 Coolant temperature too low

16 Oil level too low

17 Coolant level too low

18 Air in coolant system

19 Faulty circulation pump

20 Defective thermostat

21 Blocked charge air cooler

22 Oil level too high

23 Alternator drive belt slips

24 Water entry into engine

25 High back pressure in the exhaust system

26 Break in ”Pot+” cable to throttle

27 High temperature, charge air cooler

28 Blocked radiator

29 No pressure in cooling system

30 Check wastegate function

Diagnostic Function

The diagnostic function monitors and controls that the EMS system functions normally. The diagnostic function has the following tasks:

- Detecting and locating disturbances
- Reporting detection of disturbances
- Providing guidance when fault tracing

NOTICE! With the DCU:n it is possible choose the language that the inform-tion is presented in.

If the diagnostic function detects a disturbance in the system, this is reported using fault codes via the instruments.
Both active (unrectified) and passive (rectified) faults are stored in the control unit.
Refer to the “Operation” heading for reading fault codes/fault messages.
All fault codes and fault messages are found in the fault code list, with information about the reason, reaction and measures to be taken. Refer to *Fault Code Register*.

NOTICE! All instruments are optional.

Affect on engine

Engines are affected differently, depending on the severity of the fault discovered by the diagnostic function.
A fault message in the form of a fault code is always generated when a malfunction is discovered by the diagnostic function.
Engines are affected differently, depending on the severity of the fault:

- The engine is not affected
- Engine goes to idle
- Engine torque is restricted to a certain amount
- Engine is stopped

Active and Inactive Faults

Active faults
At the same time, the fault is stored in the control unit memory. When the fault has been attended to and the ignition is switched off and on again, the fault disappears as active.

DCU (Display Control Unit)

- text **!! ENGINE WARNING !!** shown on the display.

CIU (Control Interface Unit)

- the diagnostic lamp starts to flash.
- **"Easy Link" instrument**
  - the relevant lamp on the alarm panel lights up
  - after the diagnostic button has been pressed, the fault code is shown as text on the tachometer display.

DU (Display Unit)

- Either **WARNING!** or **ALARM STOP** (a buzzer sounds) will be shown on the display, depending on the severity of the fault.
- Fault codes can also be read off using the VODIA tool. For instructions, see "VODIA User's Guide".

Inactive faults

- DCU – the fault is indicated as passive
- CIU – the diagnostic lamp goes out
- DU – the fault message disappears (inactive faults cannot be read out)
- Easy Link – the lamp on the alarm panel goes out

Operation

When a malfunction has occurred and the diagnostic system has generated one or more fault codes, these are read out differently depending on the equipment used. Please refer to *Fault code messages*.
If the system indicates that a fault code has been set:

1. Cut engine speed to idle, or shut the engine off.
2. **For DCU/DU**
   Read the fault code from the display, please refer to **Reading fault codes via the DCU** or **Reading fault codes via the DU**.
   For CIU
   press the diagnostic button and read the fault code, by observing the flashing of the diagnostic lamp. Refer to **Reading fault codes via the diagnostic lamp, CIU.**
3. Look up the fault code in the *Fault Code Register* chapter and take the recommended measures.

Reading fault codes via the DU (Display Unit)
Depending on the severity of the fault the text, either **WARNING!** or **ALARM STOP** (a buzzer sounds) will be shown on the display

1. Press any button to come to the fault list. The fault list shows operation hours and fault message.
2. Look up the fault code in *Fault Code Register* and take the recommended measures.
3. Press on **ACK** to acknowledge the fault code. The display background will change color (the buzzer stops sounding).
4. Press on **EXIT** to leave the fault list.

Reading fault causes via the DCU (Display Control Unit)
When a fault code is set, the following text is shown on the display:
!! ENGINE WARNING !!
alternated with**Press SEL for information**.
Read the fault code as follows:

1 Press **SEL**-button to come to the fault list.
The fault list shows:
-Operation hours
-Fault message
-Active/inactive

2 Look up the fault code in the*Fault Code Register* chapter and take the recommended measures.

3 Press **ESC**-button to leave the fault list.

NOTICE! To enter the fault list when no fault code has been set, press the **SEL** button and select **Diagnostics** from the menu.

Reading fault codes via the diagnostic lamp on the instrument panel, CIU
When the system has discovered a malfunction, the diagnostic lamp starts to flash. If the diagnostic button is depressed and then released, a fault code is flashed out.
The fault code consists of two groups of flashes, separated by a pause of two seconds. A fault code is obtained by counting the number of flashes in each group
Example: ☼-☼ paus ☼-☼-☼-☼ = Fault Code 2.4
The fault code is stored and can be read as long as the malfunction remains. You can find information about cause, reaction and actions in the *Fault Code Register* chapter.
Read the fault code as follows:

1 Press the diagnostic button.

2 Release the diagnostic button and make a note of the fault that is flashed out.

3 Repeat items 1-2. A new fault code is flashed ou tif more are stored. Repeat until the first fault code is repeated.

NOTICE! When the first fault code reoccurs, all the fault codes have been read.
If the diagnostics button is depressed after the fault has been corrected and the fault code deleted, the **code 1.1,** No fault, will be shown.

Reading fault codes via an “Easylink” instrument
When the system has discovered a malfunction, this is reported by the diagnostic lamp which starts to flash.

1 Press the diagnostic button. The fault code is shown as text on the tachometer display.

2 Look up the fault code in the *Fault Code Register* chapter and take the recommended measures.

3 When the fault has been rectified, the fault code disappears from the display and the diagnostic lamp goes out.

Erasing fault codes
Fault codes must be erased by an authorized Volvo Penta workshop by means of the VODIA tool.

Fault Code Register

No fault (Code 1.1)

Cause	Reaction	Remedy
There are no active faults.		

Preheating Relay (Code 5.4, PID 45/SPN 626)

Cause	Reaction	Remedy
• Short circuit to positive (+) or earth (ground) (–). • Open circuit.	• Preheating can not be activated. • Preheating is constantly connected.	• Check that the relay input cable is not damaged. • Check relay function.

Fuel Pressure Sensor (Code 3.6, PID/SPN 94)

Cause	Reaction	Remedy
• Short circuit to positive (+) or earth (ground) (–). • Open circuit.	• None	• Check that the fuel pressure sensor connector is correctly installed. • Check that the fuel pressure sensor cable is not damaged. • Check that the fuel pressure sensor is correctly installed. • Check fuel pressure sensor function.

Fuel Pressure (Code 3.8, PID/SPN 94)

Cause	Reaction	Remedy
• Low supply pressure	• None	• Check if it is possible to build up pressure with the hand pump • Check the fuel filter • Check the fuel pre-filter

Water in Fuel (Code 2.1, PID/SPN 97)

Cause	Reaction	Remedy
• Water in fuel	• None	• Empty the primary fuel filter

Indicator for Water in Fuel (Code 2.9, PID/SPN 97)

Cause	Reaction	Remedy
• Short circuit • Open circuit • Fault in indicator	• None	• Check the indicator cables for breaks and short circuits • Check indicator function. Change indicator as necessary

Oil Level (Code 5.7, PID/SPN 98)

Cause	Reaction	Remedy
• Oil level to low	• None	• Check the oil level

Oil Level Sensor (Code 5.9, PID/SPN 98)

Cause	Reaction	Remedy
• Shorted to plus (+) or minus (-) • Break	• None	• Check that the cable harness to the oil level sensor has not been damaged • Check the oil level sensor function

Oil Pressure Sensor (Code 3.1, PID/SPN 100)

Cause	Reaction	Remedy
• Short circuit to positive (+) or earth (ground) (–) • Open circuit	• None	• Check that the oil pressure sensor cable is not damaged • Check that the oil pressure sensor is correctly connected

Oil Pressure (Code 6.6, PID/SPN 100)

Cause	Reaction	Remedy
• Oil pressure is too low	• Engine control module reduces engine power (unless the protection has been shut off with the VODIA diagnostic tool)	• Check oil level • Check that the air filter is not blocked • Check system pressure valves and safety valves in the oil system • Check oil pressure sensor function

Boost Temperature Sensor (Code 3.2, PID/SPN 105)

Cause	Reaction	Remedy
• Short circuit to positive (+) or earth (ground) (–) • Open circuit	• None	• Check that the boost temperature sensor connector is correctly installed • Check that the boost temperature sensor cable is not damaged • Check that the boost temperature sensor is correctly installed • Check boost temperature sensor function

Boost Temperature (Code 6.2, PID/SPN 105)

Cause	Reaction	Remedy
• Boost temperature is too high	• Engine control module reduces engine power (unless the protection has been shut off with the VODIA diagnostic tool)	• Check the coolant level • Check the charge air cooler (cleanliness) • Check boost temperature sensor function • Check the function of the thermostat

Boost Pressure Sensor (Code 3.4, PID/SPN 102/106)

Cause	Reaction	Remedy
• Short circuit to positive (+) or earth (ground) (–) • Open circuit	• Engine smokes more than normally during acceleration/ load increase	• Check that the boost pressure sensor connector is correctly installed • Check that the boost pressure sensor cable is not damaged • Check that the boost pressure sensor is correctly installed • Check boost pressure sensor function

Boost Pressure Sensor (Code 3.5, PID/SPN 106)

Cause	Reaction	Action
• High charge pressure	• Engine power is reduced or engine stops.	• Check that the charge air pressure sensor connector is correctly installed • Check that the charge air pressure sensor cable is not damaged • Check that the charge air pressure sensor is correctly installed • Check charge air temperature sensor function

Air Filter Pressure (Code 5.5, PID/SPN 107)

Cause	Reaction	Remedy
• Too large pressure drop across filter	• Less good response from engine	• Check the air filter

Air Filter Sensor (Code 5.6, PID/SPN 107)

Cause	Reaction	Remedy
• Shorted to plus (+) or minus (-) • Break	• None	• Check that the air filter sensor contact is correctly installed • Check that the cable harness to air filter sensor has not been damaged • Check the air filter sensor functionality

Coolant Temperature Sensor (Code 3.3, PID/SPN 110)

Cause	Reaction	Remedy
• Short circuit to positive (+) or earth (ground) (–) • Open circuit	• Preheating is also activated when the engine is hot	• Check that the coolant temperature sensor connector is correctly installed • Check that the coolant temperature sensor cable is not damaged • Check that the coolant temperature sensor is correctly installed • Check coolant temperature sensor function

Coolant Temperature (Code 6.1, PID/SPN 110)

Cause	Reaction	Remedy
• Coolant temperature is too high	• Engine control module reduces engine power (unless the protection has been shut off with the VODIA diagnostic tool)	• Check the coolant level • Check the charge air cooler (cleanliness) • Check if there is air in the cooling system • Check the pressure cap on the expansion tank • Check coolant temperature sensor function • Check thermostat function

Coolant Level (Code 2.2, PID/SPN 111)

Cause	Reaction	Remedy
• Low coolant level	• Engine control module reduces engine power (unless the protection has been shut off with the VODIA diagnostic tool)	• Check the coolant level • Check coolant level monitor function

Coolant Level Sensor (Code 2.3, PID/SPN 111)

Cause	Reaction	Remedy
• Short circuit to positive (+) • Fault in sensor	• None	• Check that the coolant level sensor cable is not damaged • Check coolant level sensor function

Crankcase Ventilation Pressure (Code 7.7, PID/SPN 153)

Cause	Reaction	Remedy
• Crankcase ventilation pressure too high	• The engine is shut down (if the protection has notbeen shut off by the parameter tool)	• Check whether the crankcase ventilation is blocked • Check whether cylinder liners, pistons or piston rings are worn or damaged

Crankcase Ventilation Pressure Sensor (Code 7.8, PID/SPN 153)

Cause	Reaction	Remedy
• Shorted to plus (+) or minus (-) • Break	• None	• Check that the crankcase ventilation pressure sensor contact is correctly installed • Check that the cable harness to the crankcase ventilation pressure sensor has not been damaged • Check that the crankcase ventilation pressure sensor correctly installed • Check crankcase ventilation pressure sensor function

Battery Voltage, EMS (Code 3.9, PID/SPN 158)

Cause	Reaction	Remedy
• Faulty alternator • Faulty battery, battery cables	• None	• Check the supply voltage from the control unit

Battery Voltage, CIU (Code 6.9, PID/SPN 158)

Cause	Reaction	Remedy
• Short circuit to negative (-) • Faulty alternator • Faulty battery, battery cables	• Problems in engine starting	• Check the supply voltage from the control unit • Check the batteries • Check the alternator • Check the 8-pin contact

Air Temperature Sensor, Inlet (Code 7.9, PID/SPN 172)

Cause	Reaction	Remedy
• Shorted to plus (+) or minus (-) • Break	• None	• Check that the air temperature sensor contact is correctly installed • Check that the cable harness to the air temperature sensor has not been damaged • Check that the air temperature sensor is correctly installed • Check the air temperature sensor functionality

Oil Temperature Sensor (Code 3.7, PID/SPN 175)

Cause	Reaction	Remedy
• Shorted to plus (+) or minus (-) • Break	• None	• Check that the cable harness to the oil temperature sensor has not been damaged • Check that the oil temperature sensor has been connected correctly

Oil Temperature (Code 5.8, PID/SPN 175)

Cause	Reaction	Remedy
• Oil temperature is too high	• The engine control module limits engine output(unless protection has been turned off with thediagnosis tool VODIA)	• Check the oil level • Check the oil temperature • Check the oil temperature sensor function

Engine Speed (Code 2.6, PID/SPN 190)

Cause	Reaction	Remedy
• Engine speed too high	• None	• After the engine has stopped, look for the reason for the high speed

Starter Input CIU (Code 5.2, PPID 4/SPN 520194)

Cause	Reaction	Remedy
• Shorted to minus (-) • Activated for too long	• The engine cannot be started • The engine starts immediately when ignition is turned on	• Check that connections to the ignition key/start panel have not been damaged • Check that the cable harness to the ignition key/start panel has not been damaged

Stop Input CIU (Code 5.3, PPID 6/SPN 52095)

Cause	Reaction	Remedy
• Short circuit to negative (-) • Open circuit • Activated for too long time	• Engine can only be stopped with the auxiliary stop (AUX STOP) on engine • Engine stops. A fault code is displayed for 40 seconds and the engine can not be started during this time. When a fault code is active, the engine can be started but not stopped	• Check that the starter switch connections are not damaged • Check that the ignition switch cable is not damaged

Stop Input EMS (Code 4.8, PPID 6/SPN 970)

Cause	Reaction	Remedy
• Short circuit to negative (-) • Open circuit	• Engine can only be stopped with the auxiliarystop	• Check that the starter switch connections are not damaged

Start output/Start motor relay (Code 4.6, PPID 3/ SPN 677)

Cause	Reaction	Remedy
• Shorted to plus (+) or minus (-) • Activated for too long	• The engine cannot be started • The engine starts immediately when ignition is turned on	• Check that connections to the ignition key/start panel have not been damaged • Check that the cable harness to the ignition key/sart panel has not been damaged

Piston Cooling Pressure (Code 6.7, PPID 8/SPN 520192)

Cause	Reaction	Remedy
• Piston cooling pressure is too low	• Engine stopped	• Check that the oil pressure in the engine exceeds175 kPa (25.4 psi)

Piston Cooling Pressure Sensor (Code 6.8, PPID 8/SPN 520192)

Cause	Reaction	Remedy
• Shorted to plus (+) or minus (-) • Break	• None	• Check that the piston cooling pressure sensor contact is correctly installed • Check that the cable harness to the piston cooling pressure sensor has not been damaged • Check the piston cooling pressure sensor functionality

Internal EGR (Code 8.5, PPID 19/SPN 2791)

Cause	Reaction	Remedy
• Fault in cable harness (boost pressure sensor) • Mechanical fault on the IEGR	• Engine control module reduces engine power	• Check cable harness (boost pressure sensor) • Check the IEGR • Contact a Volvo Penta authorized workshop

ECU Temperature (Code 8.4, PPID 55/SPN 1136)

Cause	Reaction	Remedy
• Control unit too hot, incorrect assembly • Electrical fault, damaged sensor	• None	• Check the control unit installation. Recommended ambient temperature is 50°C (122°F)

Speed Potentiometer Connected to CIU (Code 2.8, PPID 132/SPN 91, 608,)

Cause	Reaction	Remedy
• Shorted to plus (+) or minus (-) • Fault in sensor	• Engine goes to idle • Speed feezes	• Check that the potentiometer has been connected correctly • Check that the cable harness to the potentiometer has not been damaged • Check the potentiometer function

SInjector, Cylinder #1 (Code 7.1, SID 1/SPN 651)

Cause	Reaction	Remedy
• Electrical fault • Faulty compression or injector	• Engine runs on 5 cylinders • Abnormal sound • Reduced performance	• Check that the injector cables are not damaged • Check that the injector connections are not damaged • Check fuel supply pressure • Check the valve clearance • Do a compression test and check cylinder #1

Injector, Cylinder #2 (Code 7.2, SID 2/SPN 652)

Cause	Reaction	Remedy
• Electrical fault • Faulty compression or injector	• Engine runs on 5 cylinders • Abnormal sound • Reduced performance	• Check that the injector cables are not damaged • Check that the injector connections are not damaged • Check fuel supply pressure • Check the valve clearance • Do a compression test and check cylinder #2

Injector, Cylinder #3 (Code 7.3, SID 3/SPN 653)

Cause	Reaction	Remedy
• Electrical fault • Faulty compression or injector	• Engine runs on 5 cylinders • Abnormal sound • Reduced performance	• Check that the injector cables are not damaged • Check that the injector connections are not damaged • Check fuel supply pressure • Check the valve clearance • Do a compression test and check cylinder #3

Injector, Cylinder #4 (Code 7.4, SID 4/SPN 654)

Cause	Reaction	Remedy
• Electrical fault • Faulty compression or injector	• Engine runs on 5 cylinders • Abnormal sound • Reduced performance	• Check that the injector cables are not damaged • Check that the injector connections are not damaged • Check fuel supply pressure • Check the valve clearance • Do a compression test and check cylinder #4

Injector, Cylinder #5 (Code 7.5, SID 5/SPN 655)

Cause	Reaction	Remedy
• Electrical fault • Faulty compression or injector	• Engine runs on 5 cylinders • Abnormal sound • Reduced performance	• Check that the injector cables are not damaged • Check that the injector connections are not damaged • Check fuel supply pressure • Check the valve clearance • Do a compression test and check cylinder #5

Injector, Cylinder #6 (Code 7.6, SID 6/SPN 656)

Cause	Reaction	Remedy
• Electrical fault • Faulty compression or injector	• Engine runs on 5 cylinders • Abnormal sound • Reduced performance	• Check that the injector cables are not damaged • Check that the injector connections are not damaged • Check fuel supply pressure • Check the valve clearance • Do a compression test and check cylinder #6

Camshaft Drive Speed Sensor (Code 2.5, SID21/SPN 636)

Cause	Reaction	Remedy
• No signal • Abnormal frequency • Fault in sensor	• Engine takes longer to start than normal. Engine runs normally when running	• Check that the engine speed sensor connector is correctly installed • Check that the engine speed sensor cable is not damaged • Check that the engine speed sensor is correctly installed in the upper timing gear cover. • Check engine speed sensor function.

Flywheel Speed Sensor (Code 2.4, SID 22/SPN 637)

Cause	Reaction	Remedy
• No signal • Abnormal frequency • “Intermittent” signal from the sensor • Fault in sensor	• Engine is very difficult to start and runs roughly when it starts	• Check that the sensor connector is correctly installed • Check that the engine speed sensor cable is not damaged • Check that the engine speed sensor is correctly installed in the flywheel housing • Check engine speed sensor function

Wastegate (SID 32/SPN 1188)

Cause	Reaction	Remedy
• Short circuit to positive (+) or negative (-) • Open circuit • Wastegate damaged mechanically	• Warning lamp lights up • Engine control unit limits engine power	• Check that the wastegate connector is properly mounted • Check that the wiring to the wastegate is not damaged • Check that the wastegate is correctly mounted • Check the wastegate

Preheating Sensor (Code 8.6, SID 70/SPN 729)

Cause	Reaction	Remedy
• Fault in cable harness • Fault in preheating relay	• Preheating can not be activated	• Check the cable harness • Check the preheating relay

Data Link (CAN), CIU (Code 6.4, SID 231/SPN 639)

Cause	Reaction	Remedy
• Faulty data link (CAN), , CIU	• Instruments and warning lamps stop working	• Check that the 8-pin connector is not damaged • Check that the cables between the CIU and the engine management unit are not damaged

Data Link (CAN), EMS 2 (Code 6.5, SID 231/SPN 639/2017/PSID 201)

Cause	Reaction	Remedy
• Internal fault in control module	• Engine not operating: engine can not be started. Engine operating: engine idles and can only be stopped with the auxiliary stop (AUX-stop)	• Check that the 8-pin connector is not damaged • Check that the cables between the CIU and the engine management unit are not damaged • Check that sleeves 11 and 12 in the connector on the CIU are not damaged

Power Supply to Sensor (Code 9.3, SID 211/232, SPN 1079/1080)

Cause	Reaction	Remedy
• Shortcut • Fault in sensor	• Faulty values in oil pressure and boost pressure sensors • Fault code for oil pressure- and boost pressure sensor • Low engine output • The instrument shows zero oil pressure and boost pressure	• Check that the cable harness to oil pressure and boost pressure sensor has not been damaged • Check oil pressure and boost pressure sensors

Memory Fault EMS (Code 9.9, SID 240/SPN 628)

Cause	Reaction	Remedy
• Memory fault in engine management system	• Engine might not start	• Re-program the unit

Faulty data link (J1587) (Code 9.2, SID 250/SPN 608)

Cause	Reaction	Remedy
• Faulty data link	• None	• Check that the 8-pin connector is not damaged • Check that the cables between the CIU/DCU and the engine management unit are not damaged

Data Set Memory EEPROM, CIU (Code 9.8, SID 253/SPN 630)

Cause	Reaction	Remedy
• Internal fault in control module • Programming faulty	• Engine does not start	• Re-program the control module.

Data Set Memory EEPROM, EMS (Code 9.9, SID 253/SPN 630)

Cause	Reaction	Remedy
• Internal fault in control module • Internal fault in control module	• Engine does not start	• Re-program the control module. If the fault remains, change the control module

Fault in Control Unit, CIU (Code 9.8, SID 254/SPN 629)

Cause	Reaction	Remedy
• Faulty EEPROM, CIU • Faulty flash memory, CIU • Fault in control module, CIU	• CIU returns to factory setting • Engine goes to idle • Engine can not be started	• Re- program the unit

Control Module EMS (Code 9.9, SID 254/SPN 629)

Cause	Reaction	Remedy
• Internal fault in control module	• Engine misfires • Engine does not start	• Change engine control unit

Injection Pressure (Code 8.3, PID/SPN 164)

Cause	Reaction	Remedy
• Fault in fuel supply • Fault in fuel pump • Fault in harness • Fault in sensor	• Warning lamp lights up • Control unit reduces engine power	• Check harness • Check sensor • Check fuel filter • Check fuel pump

Fan, rpm sensor (PID 26/SPN 975)

Cause	Reaction	Remedy
• Open circuit	• Warning lamp lights up	• Check that the fan actuator is properly mounted • Check that the wiring to the fan actuator is not damaged • Check that the fan actuator is correctly mounted • Check the fan actuator

Fan actuator (SID 33/SPN 975)

Cause	Reaction	Remedy
• Short circuit to positive (+) or negative (-) • Open circuit • Fan actuator damaged mechanically	• Warning lamp lights up	• Check that the fan actuator is properly mounted • Check that the wiring to the fan actuator is not damaged • Check that the fan actuator is correctly mounted • Check the fan actuator

Maintenance Schedule

Service Schedule

FSI = First Service Inspection **S2** = First Time Service **S** = Lubrication service **A – F** = Type of service (regular service)	**C** = Clean **R** = Replace **A** = Adjustment **L** = Lubrication **I** = Inspect (Clean, Adjust, Lubricate or Replace if necessary)

FSI	**After the first 100-200 Hours**
Fuel pre-filter, draining condensed water	**I**
Coolant Level	**I**
Drive Belts	**I**
Start and warm up engine	
Coolant/oil/fuel, leakage	**I**
Inspection with VODIA (Diagnostic Tool)	**I**
Engine and transmission, abnormal noises	**I**
Stop Engine	
Engine Oil and Oil Filters / By-pass filter(1)(2)	**R**
Restart engine	
Oil pressure / oil leakage	**I**

1) Oil change intervals vary, depending on engine type, oil grade and sulfur content of the fuel. Refer to *Technical Data page 67*.

2) Change filter at every oil change.

S2	**After the First 1000 Hours**
Valve clearance	**A**

S	**Every 50–600 Hours / at Least Every 12 Months**
Engine Oil and Oil Filters / By-pass filter(1)(2)	**R**

1) Oil change intervals vary, depending on engine type, oil grade and sulfur content of the fuel. Refer to *Technical Data page 67*.

2) Change the filters during each oil change.

A	**Every 500 Hours / at Least Every 12th Month**
Fuel Tank (sludge trap), Drain	**I**
Inspection with VODIA (Diagnostic Tool)	**I**
Fuel pre-filter, draining condensed water	**I**
Air Filter Inserts (Indicator), Engine	**I**
Radiator	**I**
Drive Belts	**I**
Batteries, electrolyte level	**I**

B	Every 1000 Hours / at Least Every 12 Months
Fuel Filter	R
Air filter insert , engine	R
Fuel pre-filter	R
Coolant Filter(1)	R

1) Not at same time as coolant change.

C	Every 2000 Hours
Valve clearance	I

D	Every 2000 Hours / at Least Every 24th Month
Turbocharger	I
Turbo, Wastegate(1)	I
Engine, with Respect to Leakage	I
Engine, with Respect to Hose and Cable Clamping	I
Engine, with Respect to Cleaning and Painting	I
Air Filter, Tank Breather	R
Air Filter, Compressor	R

1) TAD1350GE, TAD1351GE, TAD1352GE, TAD1353GE

E	Every 4000 hour / at Least Every 24 month
Belt Tensioner	I
Drive Belts	R

F	Every 8000 Hours / at Least Every 48th Month
Coolant	R

Maintenance

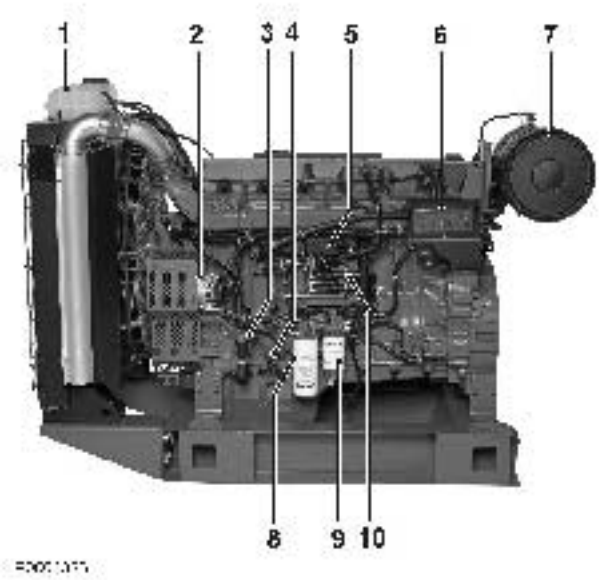
This chapter describes how the specified maintenance points in *Service Schedule page 43* should be performed, where also service intervals are stated.

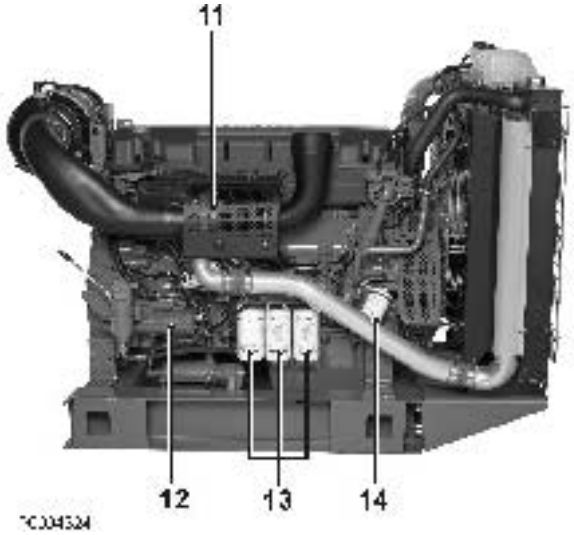
⚠ CAUTION!

Read the chapter on Maintenance before starting work. It contains instructions on how to carry out maintenance and service operations in a safe and correct manner.

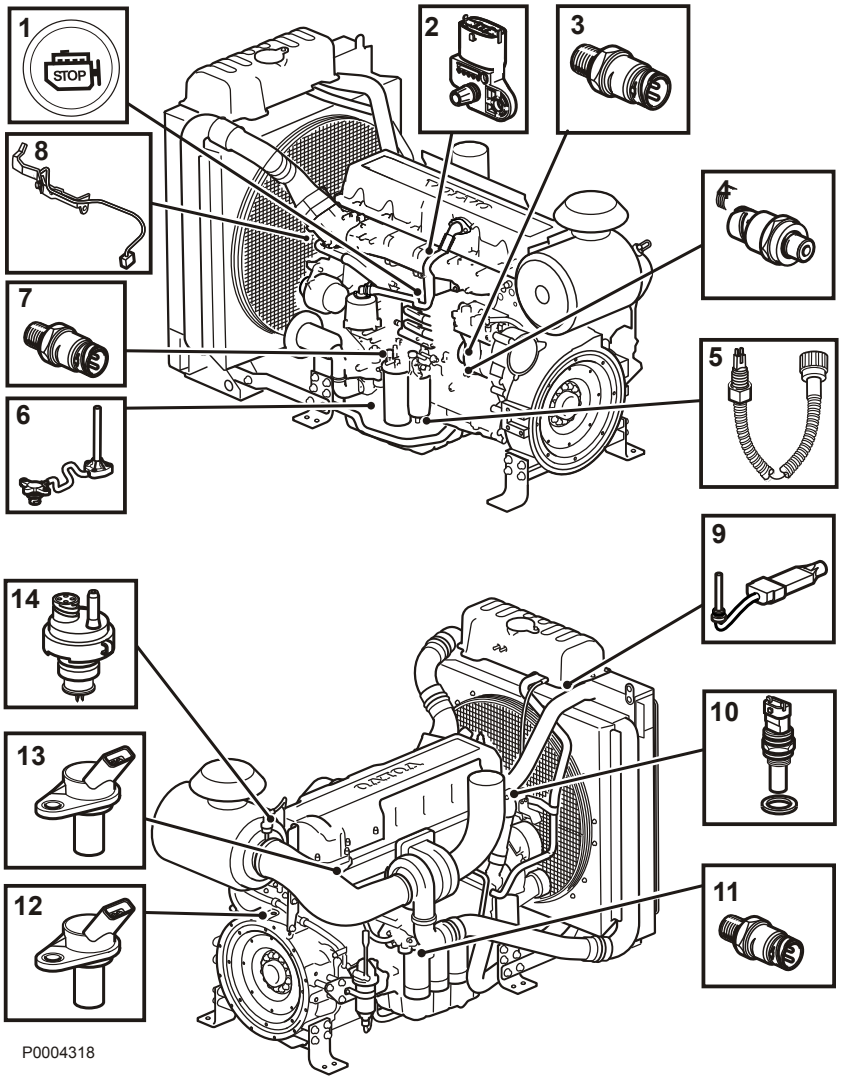
Service and maintenance work should be done with the engine stopped unless otherwise specified. Make it impossible to start the engine by removing the system voltage with the main switch.
Working with, or approaching a running engine is a safety risk. Watch out for rotating components and hot surfaces.

Orientation

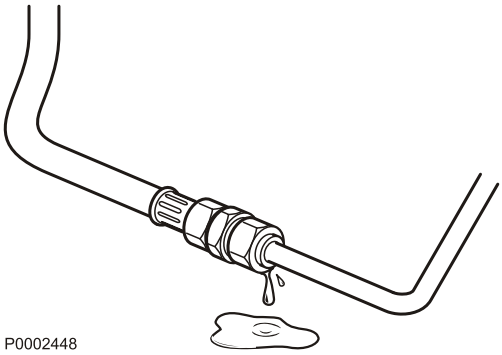




1 Expansion tank
2 Alternator
3 Oil Filler
4 Oil dipstick
5 Aux stop
6 Control panel
7 Air filter
8 Fuel filter
9 Fuel pre filter with water separator
10 Control unit, EMS
11 Turbo
12 Starter motor
13 Oil filter
14 Coolant filter



1. Extra stop
2. Combined charge air pressure and charge air temperature sensor
3. Oil pressure sensor
4. Crankcase pressure sensor
5. Water-in fuel sensor
6. Combined oil level and oil temperature sensor
7. Fuel pressure sensor
8. Fan, rpm sensor
9. Under-pressure sensor, air filter
10. Coolant level sensor, in the expansion tank
11. Coolant temperature sensor
12. Piston cooling pressure
13. Flywheel position and engine speed
14. Camshaft position

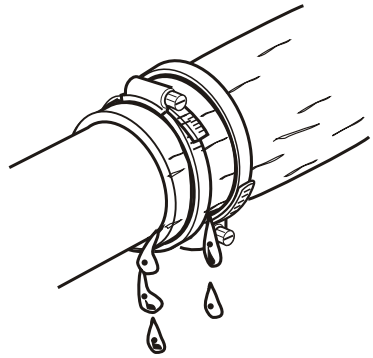


P0002448

Engine, General

General inspection

Make it a habit to give the engine and engine bay a visual inspection before starting the engine and after operation once the engine has stopped. This will help you to discover quickly if anything abnormal has happened, or is about to happen.
Look especially carefully at oil, fuel and coolant leakage, loose bolts, worn or poorly tensioned drive belts, loose connections, damaged hoses and electrical cables. This inspection only takes a few minutes and can prevent serious malfunctions and expensive repairs.



P0002455

⚠ WARNING!

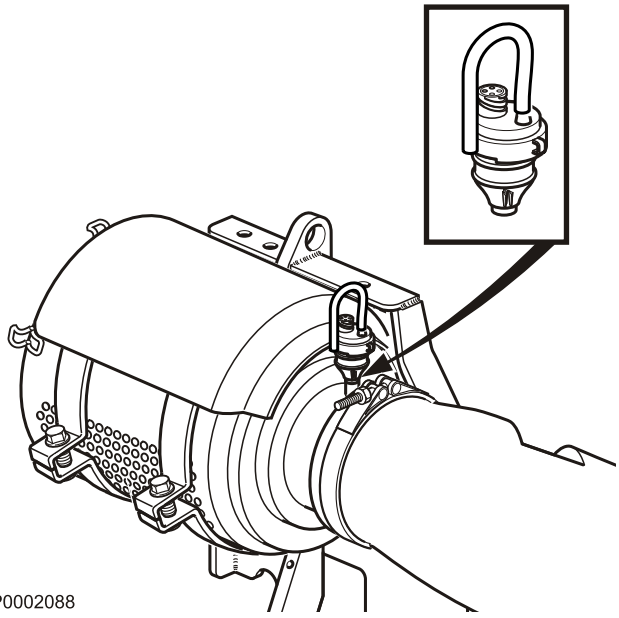
Accumulations of fuel, oil and grease on the engine or in the engine room is a fire hazard and must be removed immediately they are detected.

⚠ WARNING!

If an oil, fuel or coolant leak is detected, the cause must be investigated and the fault rectified before the engine is started.

IMPORTANT!
Remember the following when washing with a power washer: Never aim the water jet at radiators, charge air cooler, seals, rubber hoses or electrical components.

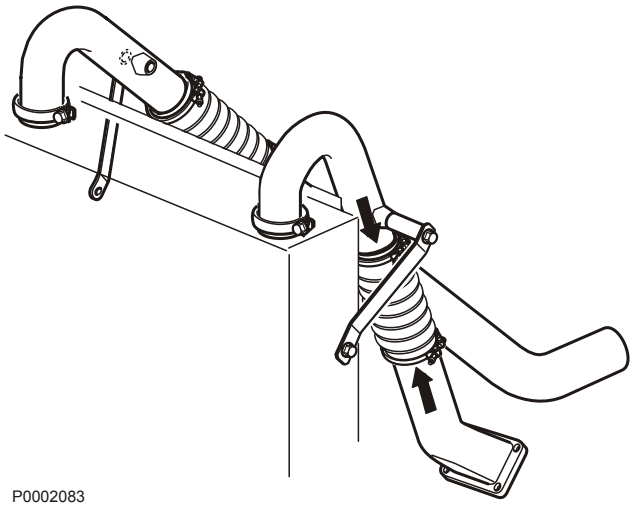
Air Filter, Check and Change



P0002088

The engine is equipped with electronic air filter indication.
The control unit provides an output signal which is announced as a warning on the instrument panel. The warning indicates a pressure drop in the air filter, which must then be checked and possibly changed.

- Scrap the old filter. No cleaning or re-use is permissible
- In continuous operation, the filter should be checked every 8 hours. For operations in extremely dirty environments such as coal mines and rock crushing mills, special air filters must be used.



P0002083

Charge Air Pipe, Leakage Check

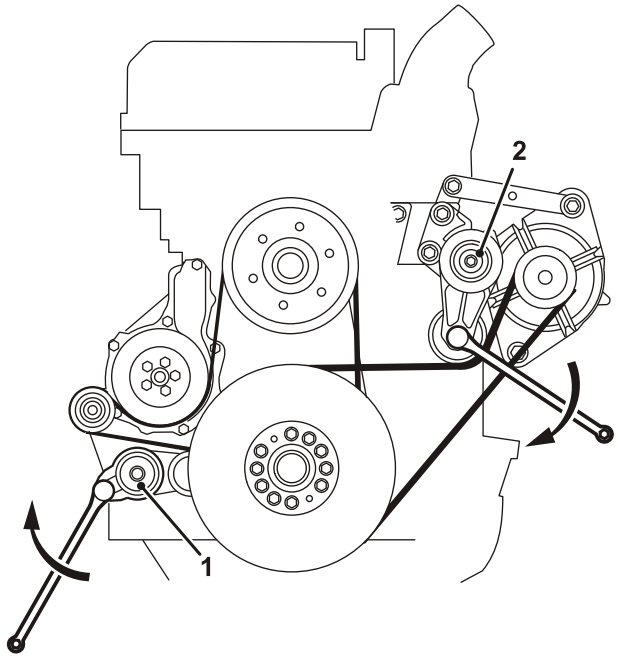
Inspect the condition of the charge air hoses, hose unions and clamp condition for cracks and other damage. Change as necessary.

IMPORTANT!

Clamps must be tightened using a torque wrench to 9 ±2 Nm (6.6 ±1.5 lbf.ft.).

Drive Belt and Alternator Belt, Inspection

Inspections must be carried out after operations, while the belts are hot.
You should be able to depress the alternator belt and the drive belt about 3-4 mm between the pulleys.
The alternator belts and drive belts have automatic belt tensioners and do not need to be adjusted.
Check the condition of the drive belts. Replace as necessary; refer to *Alternator Belts, Change page 49* and *Drive Belt, Change page 49*.



P0004319

Alternator Belts, Change

IMPORTANT!
Always replace a drive belt that seems worn or is cracked.

1 Disconnect the main switch(es) and check that the engine is not connected to system voltage.

2 Remove the fan guard and fan ring round the cooling fan.

3 Remove the belt guard.

4 Place a 1/2" square wrench in the belt tensioner (1). Lift the wrench up and lift the water pump drive belt off.

5 Place a 1/2" square wrench in the belt tensioner (2). Press the wrench down and remove the alternator belt.

6 Check that the pulleys are clean and undamaged.

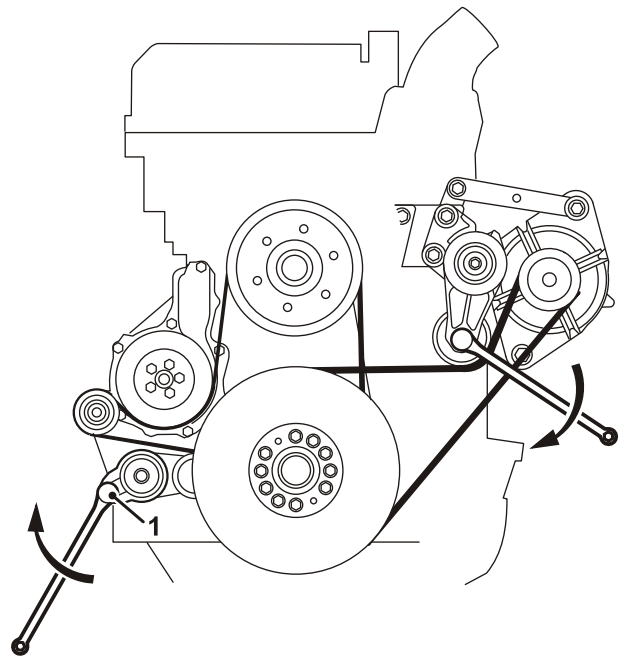
7 Press the 1/2" wrench in the belt tensioner (2) down and install the new alternator drive belt.

8 Lift the 1/2" wrench in the belt tensioner (1) and re-install the water pump drive belt.

9 Install the belt guards.

10 Install the fan guard and fan ring round the cooling fan.

11 Start the engine and perform a function check.



P0004320

Drive Belt, Change

1 Disconnect the main switch(es) and check that the engine is not connected to system voltage.

2 Remove the fan guard and fan ring round the cooling fan.

3 Remove the belt guard.

4 Place a 1/2" square wrench in the belt tensioner (1). Lift the wrench and remove the drive belt.

5 Thread the drive belt round the fan and remove it.

6 Check that the pulleys are clean and undamaged.

7 Thread the new drive belt over the fan.

8 Lift the 1/2" wrench and install the new drive belt.

9 Install the belt guards.

10 Install the fan guard and fan ring round the cooling fan.

11 Start the engine and perform a function check.

Lubrication System

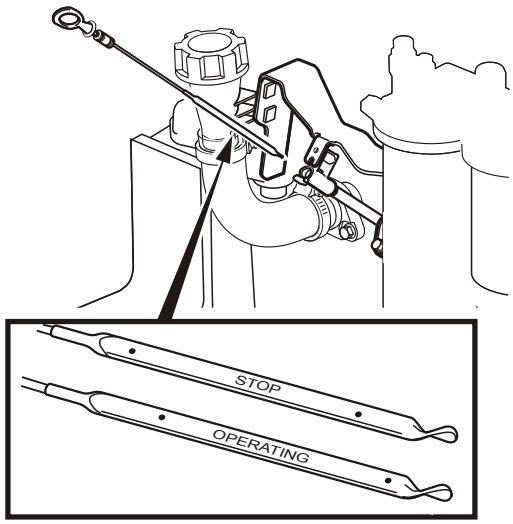
P0002089

Oil change intervalls may vary according to the lubrication oil grade and fuel sulfur content. **Refer to Technical data, Lubrication system**.

NOTICE! Oil change intervals must never exceed a period of 12 months.

If longer oil change intervals than those given in Technical data are required, the condition of the oil must be checked by the oil manufacturer via regular oil tests.

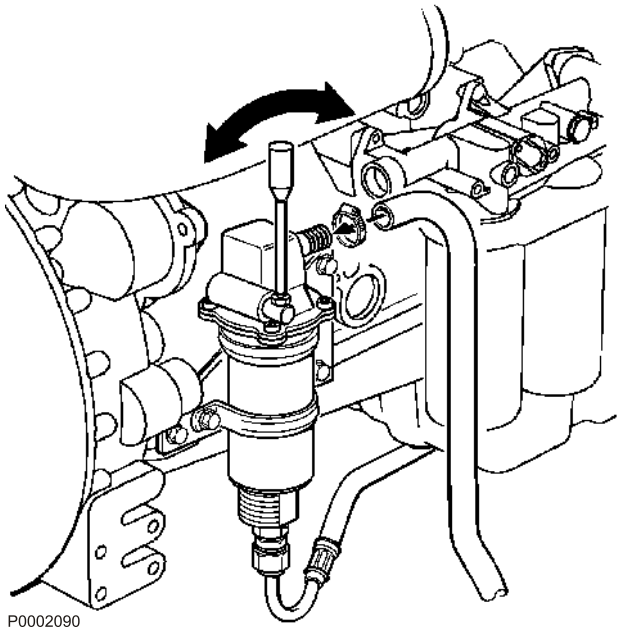
Oil level, checking and topping up



P0004311

The oil level must be inside the marked area on the dipstick and must be checked daily before the first start.

- Top up with oil via the filler opening, please refer to *Maintenance page 45*.
  Check that the correct level has been achieved. If the engine is stationary, wait for a few minutes to allow the oil to run down into the oil pan.
- The oil level can be read both when the engine is stationary (the STOP side of the dipstick) and with the engine running (the OPERATING side of the dipstick).
  Do not fill up above the maximum oillevel. Only use a recommended grade of oil, please refer to *Technical Data page 67*.
- The oil level sensor only measures the oil level at the time when the ignition is turned on. In other words, not continually during operation.


P0002090

Engine Oil, Change

⚠ WARNING!

Hot oil and hot surfaces can cause burns.

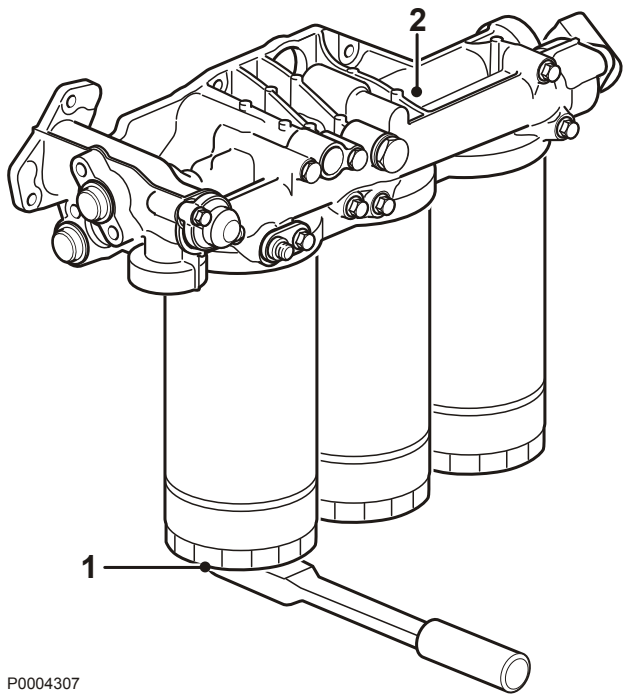
Oil changes must be done when the engine is warm.

1 Connect the drain hose to the oil drain pump and check that no leakage can occur.

2 Pump the oil out (or remove the bottom drain plug and drain the oil).
Collect all the old oil and old filters, and leave them at a re-cycling station for destruction.

3 Remove the drain hose (or install the bottom drain plug).

4 Fill with engine oil.
For change volume, please refer to *Technical Data page 67*.



P0004307

Oil Filter/By-pass Filter, Change

⚠ WARNING!

Hot oil and hot surfaces can cause burns.

1 Clean the oil filter bracket (2).

2 Remove all oil filters with a suitable oil filter extractor (1).

3 Clean the mating surface of the oil filter bracket. Make sure that no remnants of old oil seal are left behind. Carefully clean round the inside of the protective rim (2) on the oil filter bracket.

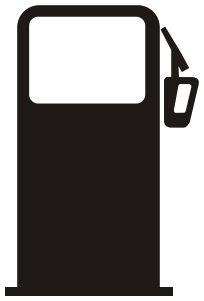
4 Put a thin layer of engine oil on the seal rings of the new oil filters.

5 Install the new oil filters. Tighten the two full-flow filters (on the right of the illustration) 1/2–3/4 of a turn after they bottom. Tighten the bypass filter 3/4–1 turn after it bottoms.

6 Top up with engine oil, start the engine and let it run for 20-30 seconds.

7 Turn off the engine, check the oil level and top up as required.

8 Check the sealing round the oil filters.



P0002101

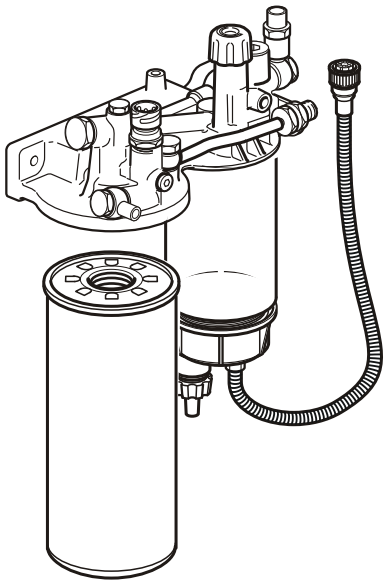
Fuel System

Only use the grades of fuel recommended in the fuel specification below, please refer to *Technical Data page 68*. Always observe the greatest cleanliness during re-fueling and work on the fuel system.

IMPORTANT!
All work on the injection system of the engine must be done by an authorized workshop.

⚠ WARNING!

Fire hazard. When carrying out work on the fuel system make sure the engine is cold. A fuel spill onto a hot surface or an electrical component can cause a fire. Store fuel soaked rags so that they can not cause fire.



P0004325

Engine Fuel Filter Replacement

The fuel filter shall be replaced while the engine is cold.

⚠ WARNING!

Fire hazard. When carrying out work on the fuel system make sure the engine is cold. A fuel spill onto a hot surface or an electrical component can cause a fire. Store fuel soaked rags so that they can not cause fire.

Do not fill the new fuel filter with fuel before assembly. There is a risk that contamination could get into the system and cause malfunctions or damage.

1 Clean round the fuel filter.

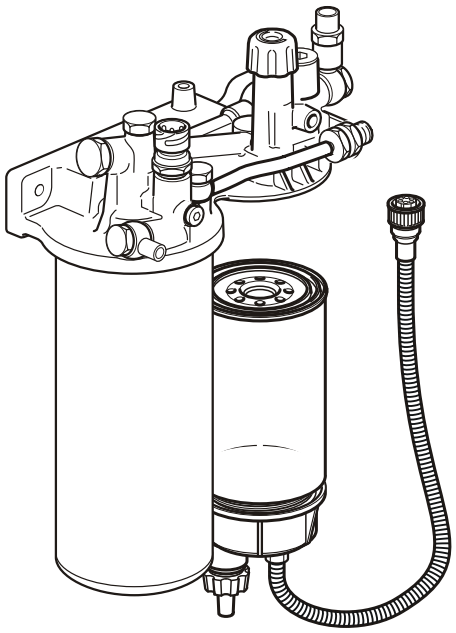
2 Remove the filter with a suitable filter remover. Collect any spilled fuel in a collection vessel.

3 Clean the filter mating surface on the filter bracket.

4 Lubricate the seal with diesel fuel and install the new fuel filter. Tighten the fuel filter in accordance with the instructions on the fuel filter.

5 Where necessary, purge the fuel system; refer to *Bleeding the Fuel System page 53*.

6 If a water trap is installed, change the filter in it at the same time as the fuel filter, and clean the water trap in the plastic bowl under the filter with a soft rag.



P0004326

Fuel Pre-filter, Change

1 Undo the cable from the water trap sensor.

2 Remove the water trap filter from the filter bracket. Collect any spilled fuel in a collection vessel.

3 Remove the lower part of the water trap from the filter.

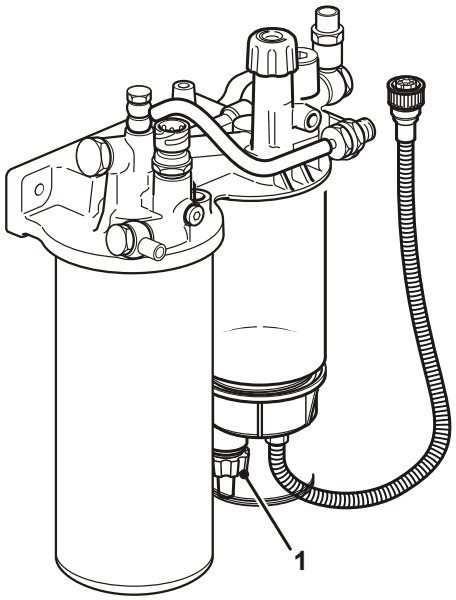
4 Clean the lower part of the water trap with a soft rag. Check that the drain hole in the lower part is not blocked.

5 Install a new seal on the lower part and lubricate the seal with diesel fuel. Re-install the lower part of the filter.

6 Lubricate the seal with diesel fuel. Screw the filter onto the filter bracket by hand until the rubber seal just touches the mating surface. Then tighten a further half turn, no more.

7 Connect the cable to the water trap sensor.

8 Where necessary, purge the fuel system; refer to *Bleeding the Fuel System page 53*.



P0004327

Draining condensate, fuel system

1 Put a collection vessel under the fuel filter to collect the condensate and fuel.

2 Open the drain nipple (1) in the base of the fuel pre-filter.

3 Tighten the drain tap (1) when fuel without water starts to run out.

Bleeding the Fuel System

The system does not need to be purged unless it has been run completely dry. Purging is then done with the hand pump on the fuel filter bracket.

Cooling System

The engine's internal cooling system makes sure the engine works at the right temperature. It is a closed system that must always be filled with a mixture of concentrated coolant and water in order to protect the engine against internal corrosion, cavitation and freeze bursting.

IMPORTANT!

Coolant of a suitable chemical composition must be used all year round. This also applies in areas where there is never any risk of freezing, to provide the engine full corrosion protection.
The corrosion protection additives become less effective over time, which means that the coolant must be changed at regular intervals; refer to the *Service Schedule page 43*. The cooling system must be flushed whenever the coolant is changed; refer to the *Cooling System, Cleaning page 59* section.

P0013077

Volvo Penta engines are delivered with either “Volvo Penta Coolant” (green) or “Volvo Penta Coolant VCS” (yellow); both are available as concentrates and “Ready Mixed”.

Volvo Penta coolants have been prepared to work best with Volvo Penta engines and offer excellent protection against corrosion, cavitation damage, and bursts due to freezing. Only coolants of this quality are adapted to, and approved by, Volvo Penta.

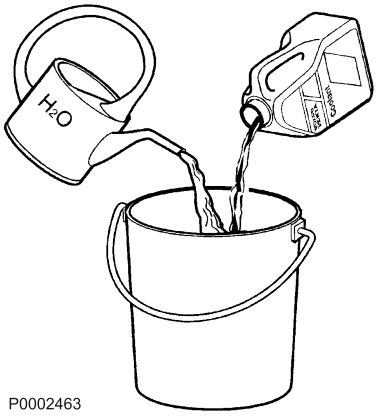
We recommend that the coolant supplied with the engine on delivery be used. Future warranty claims related to engine and accessories may be declined if an unsuitable coolant has been used, or if the instructions for coolant mixture have not been followed.
The use of anti-corrosion agents alone is not permitted in Volvo Penta engines. Never use water alone as a replacement for coolant.

IMPORTANT!

- The two types of Volvo Penta coolant may **never** be mixed with each other as this will affect the anti-corrosion properties.
- Coolant filters may not be used together with Volvo Penta Coolant VCS.
- Engines using yellow Volvo Penta Coolant VCS must have a yellow decal with the text VOLVO COOLANT VCS on the expansion tank.

Ready Mixed

Ready mixed coolant contains 40% Volvo Penta Coolant / Volvo Penta Coolant VCS and 60% water. This mixture protects against internal corrosion, cavitation and bursts due to freezing down to –28 °C (–18 °F).



P0002463

Coolant, Mixing

The concentrated coolant must be mixed with pure water (distilled or de-ionized water) according to specifications; refer to *Water Quality page 70*.

⚠ WARNING!

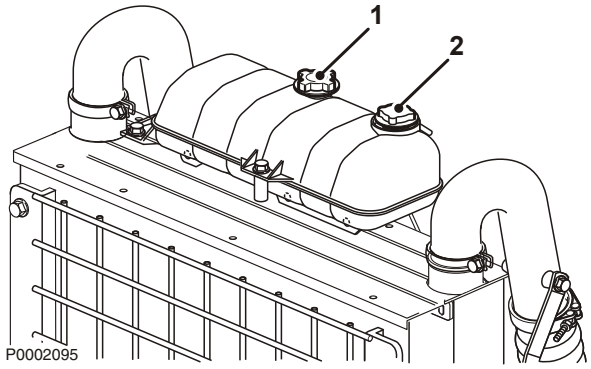
All coolant is hazardous and harmful to the environment. Do not consume. Coolant is flammable.

IMPORTANT!

Different kinds of coolant must not be mixed with each other!

Mix: 40% concentrated coolant and 60% water

This mixture protects against internal corrosion, cavitation and bursts due to freezing down to –28°C (–18°F). A 60% glycol admix lowers the freezing point to -54 °C (-65 °F).
Never mix more than 60% concentrate in the coolant. A greater concentration provides reduced cooling effect with the risk for overheating and reduced anti-freeze protection.
It is extremely important that the system be filled with the correct coolant concentration. Mix in a separate clean vessel before filling the cooling system. Make sure that the liquids mix.



Coolant Level, Checking and Topping Up

Coolant filling must be performed with the engine stopped. Check the coolant level daily before starting.

IMPORTANT!
Only use the coolant recommended by Volvo Penta. Top up with the same type of coolant as already used in the system. Different types of coolant must not be mixed.

⚠ WARNING!
Do not open the coolant filler cap when the engine is warm, except in emergencies, this could cause serious personal injury. Steam or hot fluid could spray out.

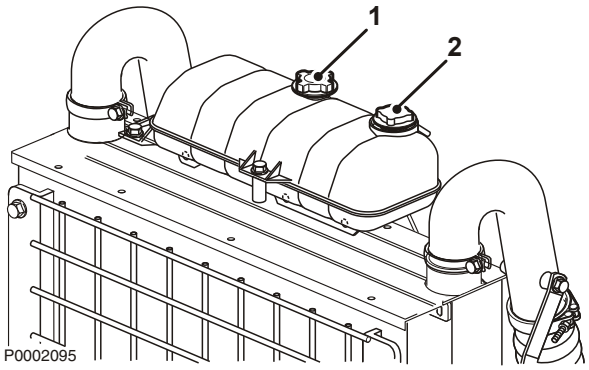
1 Only open the filler cap (1). Do not open the pressure cap (2).

2 Check that the coolant level is above the MIN mark on the expansion tank.

3 Top up with coolant as required, so that the level is between the MIN and MAX marks.
Fill slowly, to allow air to flow out.

Filling a completely empty system

NOTICE! Mix the correct amount of coolant in advance, to ensure that the cooling system is completely filled. Refer to Technical Data, Cooling System, for the correct coolant volume.



Do not open the pressure cap (2).

1 Check that all drain points are closed.

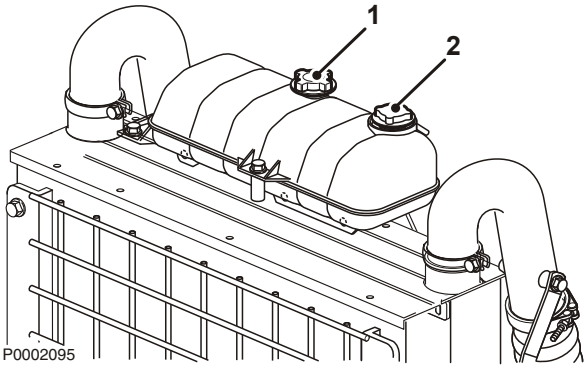
2 Open filler cap (1).

3 Fill with coolant, so that the level is between the MIN and MAX marks.
Fill slowly, to allow air to flow out.

NOTICE! Do not start the engine until the system is vented and completely filled.

4 Start the engine when the cooling system has been completely filled and vented. Open any venting taps a short while after starting, to allow trapped air to escape.
If a heating unit is connected to the engine cooling system, the heat control valve must be opened and the installation vented during filling.

5 Stop the engine after about an hour and check the coolant level. Top up as necessary.



Coolant, Draining

⚠ WARNING!

Do not open the coolant filler cap when the engine is warm, except in emergencies, this could cause serious personal injury. Steam or hot fluid could spray out.

IMPORTANT!
On engines which are to be laid up or put in storage, the engine cooling system must **not** be drained. The coolant contains corrosion-inhibiting additives.

1 Stop the engine.

2 Remove the filler cap (1). Do not open the pressure cap (2).

3 Open all drain points. Drain the coolant from the radiator and engine block, using the drain hose. The drain nipples are situated under the radiator on the right side of the engine block.

4 Check that all coolant drains out. Deposits may be found inside the drain plug/tap, and need to be cleared away. There is otherwise a risk that coolant could remain and cause frost damage. Check whether the installation has any further taps or plugs at the lowest points of the cooling water pipes.

5 Shut any taps and check that the spring-loaded covers on the nipples close completely. Install the rubber plugs.

Charge Air Cooler, External Cleaning

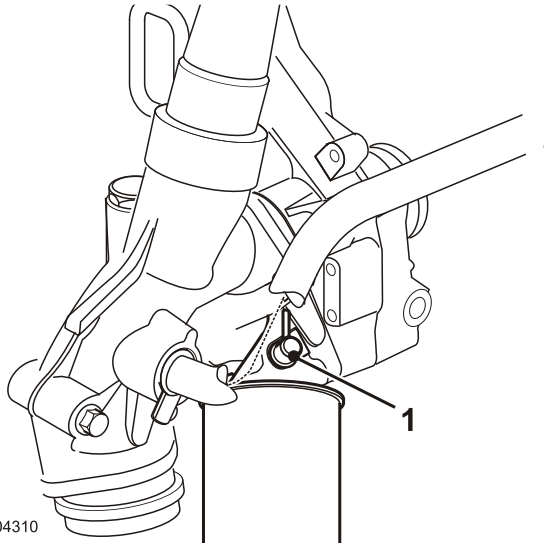
Remove guards as necessary, to access the cooler. Clean with water and a mild detergent. Use a soft brush. Be careful not to damage the radiator matrix. Re-install the components.

IMPORTANT!
Do not use a high pressure power washer.

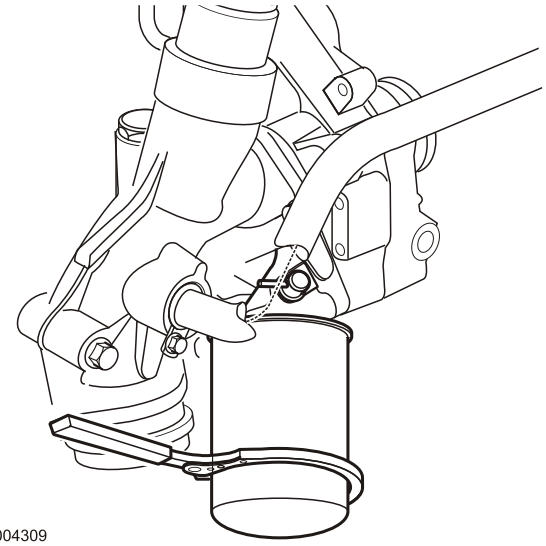
Coolant Filter, Change

NOTICE! Only applies to engines using Volvo Penta Coolant (green). Engines using Volvo Penta Coolant VCS are not fitted with coolant filters.

Open



Closed



1 Turn the tap (1) 90° to stop the flow through the coolant filter.

2 Remove the coolant filter with a suitable extractor. Make sure that no residue from the old seal remains in the housing.

3 Put a thin layer of engine oil on the new coolant filter seal. Screw the coolant filter on by hand until the seal comes into contact with the mating surface of the filter bracket. Then tighten the coolant filter a further 1/2 turn.

4 Turn the tap (1) 90° to release the flow through the coolant filter again.

5 Start the engine and carry out a leakage check.

6 Switch the engine off and check the coolant level. Refer to *Coolant Level, Checking and Topping Up page 56*.

Cooling System, Cleaning

Cooling performance is reduced by deposits in the radiator and cooling galleries. The cooling system should be cleaned out when the coolant is changed.

IMPORTANT!

Cleaning must not be done if there is any risk of the cooling system freezing, since the cleaning solution does not have any frost prevention ability.

IMPORTANT!

It is extremely important that the correct concentration and volume of coolant is put in the system. Mix in a separate clean vessel before filling the cooling system. Make sure that the liquids mix.

1 Empty the cooling system. Refer to *Coolant, Draining page 57*.

2 Put a hose into the expansion tank filling hole and flush with clean water, as specified by Volvo Penta– refer to section Water quality in *Technical Data page 70* until the water draining out is completely clear.

3 If there should still be some contamination left after flushing for a long time, cleaning can be done with coolant. Otherwise, continue as in item 8 below.

4 Fill the cooling system with 15-20 % mixture of concentrated coolant. Use only Volvo Penta recommended concentrated coolant mixed with clean water.

5 Drain the coolant after 1-2 days of operation. Remove the filler cap and possibly the lower radiator hose to increase the speed of emptying. To prevent suspended material from settling back in the system, emptying should be done rapidly, within the space of 10 minutes, when the engine has not been standing still for a long time.

6 Flush the system immediately and thoroughly with clean hot water to prevent dirt from settling in the inner areas. Flush until the water that runs out is completely clean. Make sure that any heater controls are set to full heating during emptying.

7 If contamination should still be left after a long period of flushing, you can do a cleanout with Volvo Penta radiator cleaner, followed by finishing-off with Volvo Penta neutralizer. Carefully follow the instructions on the package. Otherwise, continue as in item 8 below.

8 When the cooling system is completely free from contamination, close the drain taps and plugs.

9 Fill up with Volvo Penta recommended coolant, following the instructions in the chapters entitled *Maintenance page 54*and *Coolant Level, Checking and Topping Up page 56*.

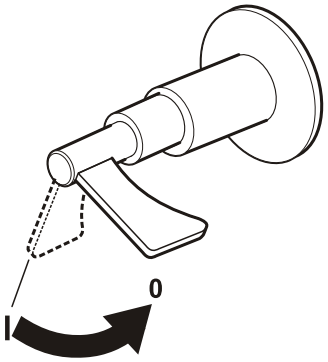
Electrical System

The engine is equipped with a 2-pole electrical system and an alternator. System voltage is 12V or 24V.

⚠ WARNING!

Always stop the engine and break the current using the main switches before working on the engine.

Main Switch



P0002576

IMPORTANT!

Never disconnect the current with the main switches when the engine is running, the alternator and electronics could be damaged.

The main switches must never be switched off before the engine has stopped. If the circuit between the alternator and the battery is disconnected when the engine is running, the alternator and electronics can be damaged. For the same reason the charging circuits must never be re-connected with the engine running.

Fuses

The engine is equipped with a 10 A circuit breaker which cuts the current if overloaded.
The circuit breaker is located on the left-hand side of the engine *Maintenance page 46*.

The engine stops if the fuse trips. If the circuit breaker trips frequently, an authorized Volvo Penta workshop should be contacted to investigate the cause of the overload.

Electrical Connections

P0002479

Check that electrical connections are dry, free from oxide, and that they are securely tightened. Spray the connections as necessary with water-repellent spray (Volvo Penta universal oil).

P0002107

Battery, Maintenance

⚠ WARNING!

Risk of fire and explosion. Never allow an open flame or electric sparks near the battery or batteries.

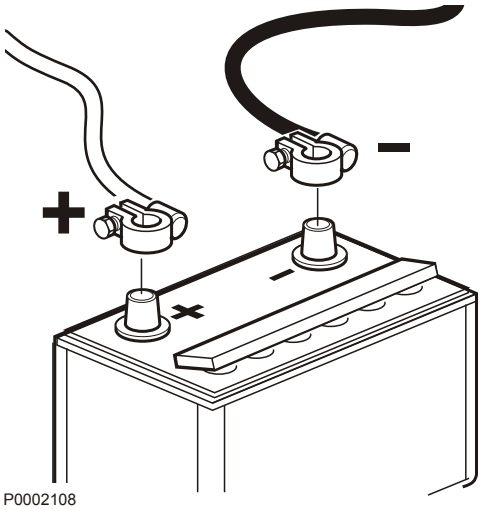
⚠ WARNING!

Never confuse the positive and negative poles on the batteries. Risk of arcing and explosion.

⚠ WARNING!

The battery electrolyte contains extremely corrosive sulfuric acid. Protect your skin and clothes when charging or handling batteries.

Always use protective goggles and gloves. If battery electrolyte comes into contact with unprotected skin whas off immediately using plenty of water and soap. If battery acid comes in contact with the eyes, flush immediately with plenty of water and obtain medical assistance without delay.



P0002108

Connecting and disconnecting the battery

Connecting

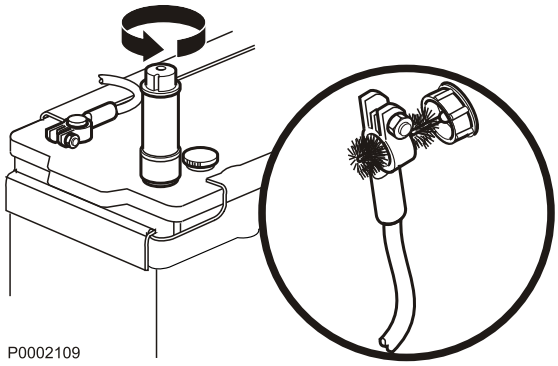
1 Connect the + cable (red) to the + pole on the battery.

2 Connect the – cable (black) to the – pole on the battery.

Disconnecting

1 Remove the – cable (black).

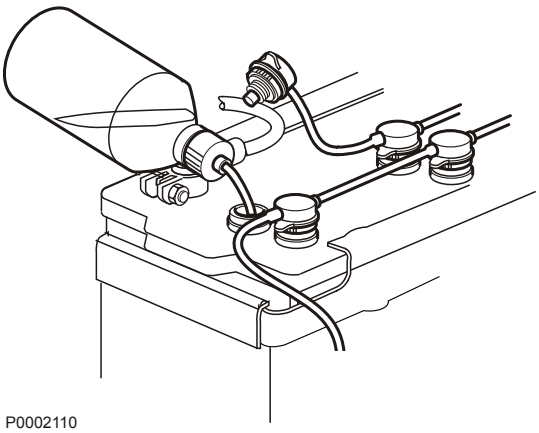
2 Remove the + cable (red).



P0002109

Cleaning

Keep the batteries clean and dry. Contamination and oxide on the batteries and battery poles can cause stray currents, voltage drop and discharge, especially in wet weather. Remove oxidation from the battery poles and terminals, using a brass brush. Tighten the terminals securely and grease them with terminal grease or petroleum jelly.



P0002110

Filling

The electrolyte level should be 5–10 mm (0.2– 0.4”) above the cell plates in the battery. Top up with distilled water as required.

After filling, the battery should be charged for at least 30 minutes by running the engine at idle.

Some maintenance-free batteries have special instructions, which must be followed.

Battery, Charging

P0002107

⚠ WARNING!

Risk of fire and explosion. Never allow an open flame or electric sparks near the battery or batteries.

⚠ WARNING!

The battery electrolyte contains extremely corrosive sulfuric acid. Protect your skin and clothes when charging or handling batteries.

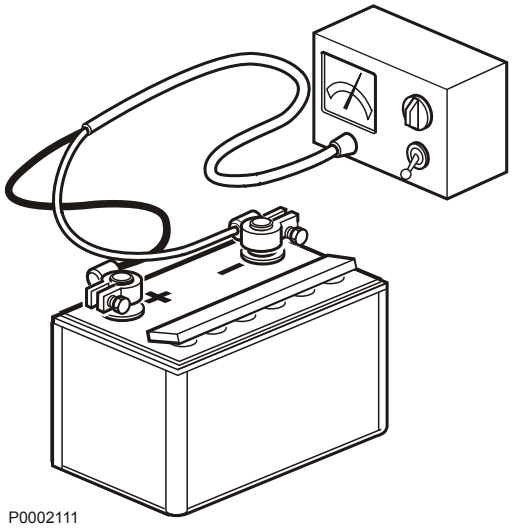
Always use protective goggles and gloves. If battery electrolyte comes into contact with unprotected skin whas off immediately using plenty of water and soap. If battery acid comes in contact with the eyes, flush immediately with plenty of water and obtain medical assistance without delay.

⚠ WARNING!

Never confuse the positive and negative poles on the batteries. Risk of arcing and explosion.

IMPORTANT!

Observe the instruction manual for the battery charger carefully. To avoid the risk of electrochemical corrosion when an external charger is connected, the battery cables should be removed from the batteries before the charger is connected.
Always switch off the charging current before the charging clips are removed.



P0002111

- Charge batteries if they have become discharged. During charging, unscrew the cell plugs but leave them in the plug holes. Ventilate well, especially if the batteries are charged in an enclosed space.
- If the engine is not used for a longer period of time, the batteries should be fully charged, then possibly trickle charged (please refer to the battery manufacturer’s recommendations). Batteries are damaged by being left discharged, and can also freeze and burst easier in cold weather.
- Special instructions apply to **boost charging**. Boost charging can shorten battery life, and should therefore be avoided.

Storage

The engine and other equipment must be laid up to prevent damage if they are not used for two months or more. It is important that this is done in the correct manner, and nothing is forgotten. For this reason, we have compiled a check list of the most important points.
Before the engine is taken out of service for a long period of time, an authorized Volvo Penta workshop should check it over. Have any faults and deficiencies attended to, so that the equipment is in order, ready for the next start.

⚠ CAUTION!

Read the chapter on Maintenance before starting work. It contains instructions on how to carry out maintenance and service operations in a safe and correct manner.

⚠ WARNING!

Conservations oils can be flammable and dangerous to breathe. Ensure good ventilation. Use a protective face mask when spraying.

IMPORTANT!

Remember the following when washing with a high pressure washer: Never aim the water jet at seals, rubber hoses or electrical components.

P0002089

- **For up to 8 month's stoppage:**
  Change the oil and oil filter on the engine, then warm it up afterwards.
  More than 8 month's stoppage:
  Conserve the lubrication and fuel systems with conservation oil. Please refer section *Conservation of the lubrication and fuel systems for more than 8 months' stoppage:*.
- Check that the coolant offers sufficient frost protection. Top up as necessary.
  Alternatively, you can drain the coolant (also drain the coolant filter).
- Drain any water and contamination from the fuel filters and fuel tank. Fill the fuel tank completely, to avoid condensation.
- Disconnect the battery cables, clean and charge the batteries. Trickle charge the batteries while the equipment is in storage.**A poorly charged battery can freeze and burst**.
- Clean the outside of the engine. Do not use a high pressure washer for engine cleaning. Touch up paint damage with Volvo Penta original paint.
- Spray the components of the electrical system with water-repellent spray.
- Check and rust-proof any control cables.
- Put a note on the engine with the date, type of conservation and the conservation oil used.
- Cover over the air filter, exhaust pipe and engine if necessary.

Bringing out of storage

- Remove any covers from the engine, air filter and exhaust pipe.
- Put the correct grade of oil into the engine, if necessary, refer to *Tekniska data, smörjsystem*. Install a new oil filter if the filter was not changed during conservation.
- Install new fuel filters and vent the fuel system.
- Check the drive belt(s).
- Check the condition of all rubber hoses, and retighten the hose clamps.
- Close the drain taps and install any drainplugs.
- Check the coolant level. Top up as necessary.
- Connect the fully charged batteries.
- Start the engine and warm it up at fast idle with no loading.
- Check that no oil, fuel or coolant leakage occurs.

Conservation of the lubrication and fuel systems for more than 8 months' stoppage:

- Drain the engine oil and fill up with **conservation oil*** to just over the MIN marking on the dipstick.
- Connect the fuel suction and return hoses to a 1/3 full jerrican containing **conservation oil*** and 2/3 diesel fuel.
- Vent the fuel system.
- Start the engine and run at a fast idle until about 2 liters (0.6 US gals) of the fluid in the jerrican have been used. Stop the engine and connect the ordinary fuel pipes.
- Drain the engine's conservation oil.
- Follow the other instructions on the previous page.

* Conservation oils are sold by oil companies.

Technical Data

Engines

Type designation	TAD1341/42/43/44/45GE
Power, Prime/Stand-by	Refer to the sales literature
Torque, Prime/Stand-by	Refer to the sales literature
No. of cylinders	6
Cylinder diameter mm/inches	131/5.16
Stroke, mm/inches	158/6.22
Cylinder volume, dm^3/in^3	12,78/779.7
Wet weight (engine only), kg/lb	1325/2921
Wet weight (incl. cooling system, air filter and frame), kg/lb	1790/3946
Firing order	1-5-3-6-2-4
Compression ratio	18,1:1
Low idle, rpm	900
High idle, rpm	1500/1800

Type designation	TAD1350/51/52/53/54/55GE
Power, Prime/Stand-by	Refer to the sales literature
Torque, Prime/Stand-by	Refer to the sales literature
No. of cylinders	6
Cylinder diameter mm/inches	131/5.16
Stroke, mm/inches	158/6.22
Cylinder volume, dm^3/in^3	12,78/779.7
Dry weight (excl. cooling system), kg/lb	1295/2855
Wet weight (excl. cooling system), kg/lb	1325/2921
Firing order	1-5-3-6-2-4
Compression ratio	18.1:1
Low idle, rpm	900
High idle, rpm	1800

Type designation	TAD1340/41/42/43/44/45VE
Power, Prime/Stand-by	Refer to the sales literature
Torque, Prime/Stand-by	Refer to the sales literature
No. of cylinders	6
Cylinder diameter mm/inches	131/5.16
Stroke, mm/inches	158/6.22
Cylinder volume, dm^3/in^3	12,78/779.7
Wet weight (engine only), kg/lb	1325/2921
Wet weight (Power Pac), kg/lb	1790/3946
Firing order	1-5-3-6-2-4
Compression ratio	18.1:1
Idle, rpm	600–1200

Lubrication System

Oil	
Change volume, including filter change, liter/US gal	36 / 9.5
Oil pressure, hot engine	
at operating speed, kPa/psi	370-520 / 54–75
at idle, min, kPa	250 / 39
Oil filter	
Full flow filter	2
By-pass filter	1
Lube oil pump	
Type	Gear driven

Oil recommendations

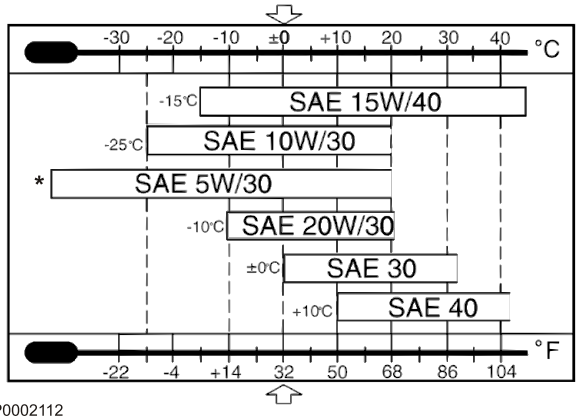
Oil garde	Sulfur content in fuel, by weight		
	up to 0.5 %	**0.5 – 1.0 %**	**more than 1.0 %** [1]
	Oil change interval: Reached first in operation:		
VDS-3	**600** hrs / 12 month	**300** hrs / 12 month	**150** hrs / 12 month
VDS-2 **and** ACEA: E7 [2] VDS-2 **and** ACEA: E5 [2] VDS-2 **and** Global DHD-1 [2] VDS-2 **and** API: CI-4 [2] VDS-2 **and** API: CH-4 [2]	**400** hrs / 12 month	**200** hrs / 12 month	**100** hrs / 12 month
VDS **and** ACEA: E3 [2]	**200** hrs / 12 month	**100** hrs / 12 month	**50** hrs / 12 month

NOTICE! Mineral based oil, as well as fully or semi-synthetic, can be used on condition that it complies with the quality requirements above.

1) If sulfur content is > 1.0 % by weight, use oil with TBN > 15.

2) Lubrication oil must comply with both requirements. Note API: CG-4 or CH-4 can be approved in markets outside Europe (instead of ACEA E3).ACEA E3).

VDS = Volvo Drain Specification
ACEA = Association des Constructeurs Européenne d'Automobiles
API = American Petroleum Institute Global
DHD = Global Diesel Heavy Duty
TBN = Total Base Number



P0002112

Viscosity

Select the viscosity from the adjacent table, for the appropriate continuous ambient air temperature.

*Refers to synthetic or semi-synthetic oils

Fuel System

Feed pump	
Feed pressure at 600 rpm	min 100 kPa (14.5 psi)
Feed pressure at 1200 rpm	min 300 kPa (43,5 psi)
Feed pressure at full load	min 300 kPa (43,5 psi)
Bypass valve	
Opening pressure	400-550 kPa (58–80 psi)

Fuel specification

The fuel must comply with national and international standards for commercially supplied fuels, such as:
EN 590 (with nationally adapted environmental and cold weather requirements)
ASTM D 975 No 1-D och 2-D
JIS KK 2204
Sulfur content: Complying with legal requirements in each country. If the sulfur content exceeds 0.5 weight-percent, the oil change intervals shall be changed, refer to *Technical Data page 67*.

Extremely low sulfur content fuel (urban diesel in Sweden and city diesel in Finland) can cause a loss of up to 5 % of power and an increase in fuel consumption of about 2-3 %.

Biodiesel

Biodiesel is also known as Fatty Acid Methyl Esters (FAME).

Volvo Penta accepts max 5% FAME in diesel fuel, in accordance with EN590, to be used without any restraint in service recommendations.

Volvo Penta accepts extended FAME use up to 30% blend in diesel fuel for engines produced after Jan 1-2009, under specific conditions and with certain limitations. Specific service requirements are applied for fuel blends with more than 5% FAME.

Engines that are manufactured by Volvo Penta are certified for the use of market diesel fuel according to EN 590. Emission requirements according to EU Stage 3A will only be met with the prescribed EN 590 diesel fuel. At the date of this document En 590 diesel fuel may contain up to 5% FAME.

Conditions

Volvo Penta engines of above are able to run with fuel blends containing up to 30% FAME under specific conditions:

- Oil quality VDS-3 or VDS-4 must be used.
- FAME must comply with EN 14214(1).
- Diesel fuel in which FAME is mixed must comply with EN 590(2).
- Specific service requirements must be fulfilled. See Service Bulletin 18-8-8, contact your Volvo Penta service dealer.

The fuel must comply with nationally laws and regional/local provisions regarding the use of FAME. The engine operator has the responsibility of using the fuel that is recommended by the manufacturer and allowed by the national legislation.

Normal rapeseed oil and other pure vegetable and animal oils do not meer EN 14214 and may not be used as fuel or as fuel additives. These products are not approved by Volvo Penta and warranties do not apply in the event of engine damage.

1) European standard that describes the quality requirements and test methods for FAME.

2) European standard that describes the quality requirements and test methods for Diesel.

Performance

The energy value of FAME is lower than for standard diesel fuel. The use of 30% FAME can result in an increase in fuel consumption with up to 5% and decrease maximum power performance by up to 4%. The engine fuel consumption data is only valid for diesel and will give incorrect readings if FAME blends are used.

Predictive maintenance on oil drain is not applicable. The exhaust fumes might smell different and visible smoke might be seen during starting when using FAME.

Cooling System

Type	Preassurized, sealed
Pressure cap, max opening pressure, kPa/psi	70 / 10.2
Volume (engine), liter US gal	20 / 5.28
Volume (engine+radiator and hoses), liter/US gal	24 / 6,34
Thermostat	
Number	1 pcs
Opening temperature	82° C / 180° F

P0002094

Water Quality

ASTM D4985:

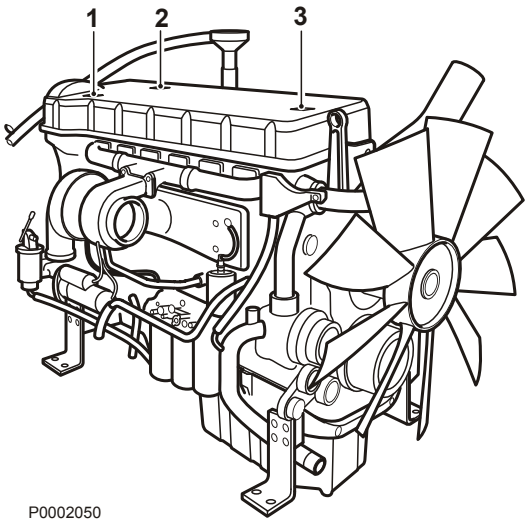
Total solid particles	<340 ppm
Total hardness	<9.5° dH
Chloride	<40 ppm
Sulfate	<100 ppm
pH value	5.5–9
Silica (acc. ASTM D859)	<20 mg SiO_2/l
Iron (acc. ASTM D1068)	<0.10 ppm
Manganese (acc. ASTM D858)	<0.05 ppm
Conductivity (acc. ASTM D1125)	<500 µS/cm
Organic content, COD_{Mn} (acc. ISO8467)	<15 mg $KMnO_4$/l

Electrical System

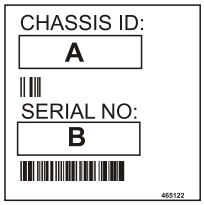
System voltage		24V
Alternator		
	voltage/max. current	28V/80A
	power app.	2200W
Battery capacity		2 pcs. series connected 12 V, max. 225 Ah
Battery electrolyte specific gravity at +25 °C:		
	fully charged battery	1.28 g/cm^3 (1.24 g/cm^3)*
	batteriet omladdas vid	1.20 g/cm^3 (1.20 g/cm^3)*

* Note. Applies to batteries with tropical acid.

Identification Numbers

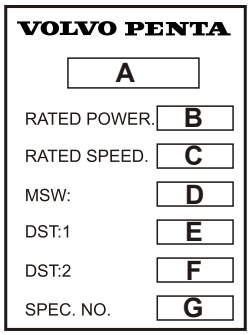


P0002050



P0002051

1
Chassis and serial number



P0002052

2

A Engine designation

B Engine power, net, (without fan)

C Max. engine speed

D Main software

E Dataset 1

F Dataset 2

G Product number

P0002053

3

1 Engine designation

2 Serial number

3 Specification number

VOLVO PENTA

Declaration for the installation of partially-completed machinery in accordance with Machinery Directive 2006/42/EC

Engine Manufacturer:

AB Volvo Penta
Gropegårdsgatan
SE 405 08 Göteborg
Sweden

Description of engine: 4-cycle diesel engine

Engine types covered by this declaration:

TAD1341GE	TAD1350GE	TAD1340VE
TAD1342GE	TAD1351GE	TAD1341VE
TAD1343GE	TAD1352GE	TAD1342VE
TAD1344GE	TAD1353GE	TAD1343VE
TAD1345GE	TAD1354GE	TAD1344VE
	TAD1355GE	TAD1345VE

Fundamental health and safety requirements applied to, and fulfilled by, the above-mentioned engines are described in the following items in Annex I; 1.1.3, 1.1.5, 1.5.1, 1.5.2, 1.5.3, 1.5.4, 1.5.6, 1.5.13, 1.6.1, 1.6.2, 1.6.4, 1.7.1, 1.7.1.1, 1.7.1.2, 1.7.4, 1.7.4.1 and 1.7.4.3.
The relevant technical documentation is compiled as described in part B of Annex VII.
Relevant information concerning the partially-completed machinery will be provided in suitable form upon justified requests from competent national authorities. The individual authorized to compile the relevant technical documentation is the signer of this declaration.

The harmonizing standards applied are:
EN ISO 12100-1: Safety of machinery - Basic concepts, general principles for design - Part 1: Basic terminology, methodology
EN ISO 12100-2: Safety of machinery - Basic concepts, general principles for design - Part 2: Technical principles
EN 1679-1: Reciprocating internal combustion engines - Safety - Part 1: Compression ignition engines

The partially-completed machinery also complies with the following relevant Directive:
2004/108/EC - Electromagnetic Compatibility (EMC) Directive
Applied Standards: EN 61000-6-1, EN 61000-6-2, EN 61000-6-3, EN 61000-6-4, EN 12895, EN-ISO 14982 and EN 13309

These engines may not be put into operation before the completed machinery into which they are to be installed has been declared to conform with the provisions of Machinery Directive 2006/42/EC.

Name and function: Tom Tveitan, Laws and Regulation
(the identity of the individual authorized to sign on behalf of the engine manufacturer or the latter's authorized representative).

Signature and title:

Date and place of issue: (yyyy/mm/dd) 2009/12/29 Gothenburg

PL-06/09

Operator's Manual Order

This Operator’s Manual may be ordered in a different language free of charge up to 12 months after delivery, via internet.

Please refer to the link below. On the web page, type in the publication number found in the bottom of this page (7–8 digits).

http://vppneuapps.volvo.com/manual/coupon/

If internet access isn't possible, please contact your Volvo Penta dealer.

All order information is stored internally at AB Volvo Penta and will not be shared with third parties.

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